JIMAR Joint Institute for Marine and Atmospheric Research



JIMAR

Annual Report for Fiscal Year 2015

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Introduction

The Joint Institute for Marine and Atmospheric Research (JIMAR) manages the Cooperative Institute for the Pacific Islands Region, one of 16 NOAA cooperative institutes nationwide. JIMAR's mission is to conduct research that is necessary for understanding and predicting environmental change in the Pacific Islands Region, conserving and managing coastal and marine resources in island environments, notably the Hawaiian Islands and the U.S.affiliated Pacific Islands, and supporting the region's economic, social, and environmental needs. JIMAR seeks to:

- facilitate innovative collaborative research between scientists at NOAA and the University of Hawaii;
- provide educational opportunities for basic and applied research in the Life and Earth Sciences at the undergraduate, graduate, and post-doctoral levels;
- sponsor interactions through the support of visiting scientists and postdoctoral scholars;



promote the transition of research outcomes to operational products and Mark Merrifield, Director services that benefit the Pacific Islands Region.

JIMAR is located at the University of Hawaii, a research-intensive land-grant institution that maintains a service mission to the State as well as to the Pacific Islands Region. JIMAR is a unit within the School of Ocean and Earth Science and Technology (SOEST), which has developed several centers of excellence in marine, atmospheric, and earth sciences that align substantially with the mission interests of NOAA. The University also provides capacity for social science research via several academic units. Adjacent to the UH campus is the independent, publicly funded East-West Center, which provides policy analysis and applied science across the Pacific Rim. JIMAR serves as a bridge to facilitate engagements between NOAA in the Pacific Region and these academic research units.

The principal NOAA Line Office for JIMAR is the National Marine Fisheries Service (NMFS), and JIMAR collaborates closely with the Pacific Island Fisheries Science Center (PIFSC) at the Inouye Regional Center (IRC). The ~100 JIMAR scientists within PIFSC are oceanographers, marine biologists, zoologists, geographers, coastal and environmental scientists, economists, fisheries scientists, sociologists, computer scientists, and engineers. The work with PIFSC is undertaken across ~20 JIMAR projects ranging from coral reef monitoring and research, marine mammal and turtle research, human dimensions investigations and economics of fisheries, fisheries bycatch mitigation research, oceanic and reef ecosystems modeling, insular and pelagic fisheries stock assessment research, fisheries database management, and more.

JIMAR also interacts with the NOAA NWS, NESDIS, and OAR Line Offices, which support a number of projects in the research themes of Equatorial Oceanography, Climate Research and Impacts, Tropical Meteorology, and Tsunamis and Other Long-period Ocean Waves. JIMAR programs active in these areas include the University of Hawaii Sea Level Center (UHSLC), Pacific ENSO Applications Climate Center (PEAC), and Pacific Island Ocean Observing System (PacIOOS).

JIMAR research covers eight themes, all aligned with the NOAA strategic plan and the University's Indo-Pacific mission. The themes are: (1) ecosystem forecasting; (2) ecosystem monitoring; (3) ecosystem-based management; (4) protection and restoration of resources; (5) equatorial oceanography; (6) climate research and impacts; (7) tropical meteorology; and (8) tsunamis and other long-period waves.

JIMAR researchers continued to excel during FY 2015, particularly in the areas of collaboration with PIFSC. Here are some highlights of joint research conducted between JIMAR and PIFSC during FY 2015.

In June 2015, the second annual NOAA Fisheries Science Camp was held at the Inouye Regional Center (IRC) under the theme Using Technology to Study Ocean Life and Ecosystems. The target audience was eighth graders from public and charter schools, with an emphasis on reaching under-represented students. This fourday camp for 45 students consisted of modules including marine debris, fishery sampling techniques and stock assessment, fish life history and dissection, marine food webs, plankton, Hawaiian monk seal "crittercam", fishing gear and techniques, sustainable fisheries, and sea safety. The Science Camp was organized by NOAA Fisheries staff and JIMAR Communications Team employees from the Pacific Islands Regional Office (PIRO). Over 35 NOAA and JIMAR scientists from PIRO and PIFSC participated in the educational activities, providing unique hands-on experiences. They also exposed campers to the diversity of career fields represented at NOAA Fisheries.

- In 15 years of surveying coral reef fishes around Pacific islands, the Fish Team in the PIFSC Coral Reef Ecosystem Division (CRED) has amassed one of the world's largest datasets of reef fishes. This dataset has been instrumental in contributing to a better understanding of the health of Pacific coral reef ecosystems. The Fish Team recently conducted surveys in the Line Islands (a series of remote atolls and low islands in the central Pacific) and surpassed a major benchmark—five million fish sized!
- Simulation testing is an important approach to evaluate the ability of stock assessment models to accurately estimate stock conditions under a range of scenarios. Yi-Jay Chang et al. ("Model selection and multi-model inference for Bayesian surplus production models: A case study for Pacific blue and striped marlin", *Fisheries Research*, 166, 129-139, 2015) applied Monte Carlo simulation techniques to address model selection uncertainty of Bayesian state-space surplus production models using assessment data for blue marlin in the Pacific Ocean and striped marlin in the western and central North Pacific Ocean. These models have different structural assumptions related to production curves and/or population intrinsic growth rates. The results of the simulations suggest that mis-specification of time-varying growth rate can lead to large estimation errors for biomass and management quantities. The study demonstrated the importance of simulation-based evaluation of model performance and recommend simulation studies to evaluate the performance of stock assessment models for any species.
- The study carried out by Felipe Carvalho et al. ("Using pop-up satellite archival tags to inform selectivity in fisheries stock assessment models: A case study for the blue shark in the South Atlantic Ocean", *ICES Journal of Marine Science*, 72, 1715-1730, 2015) provides evidence that data from tagging studies can be directly integrated in population dynamic models to capture some of the spatial variability of pelagic fish species. The results will assist in implementing better stock assessment models and management advice for such species worldwide.
- The paper by Laurie Richmond, Dawn Kotowicz, and Justin Hospital ("Monitoring socioeconomic impacts of Hawai'i's 2010 bigeye tuna closure: complexities of local management in a global fishery", *Ocean and Coastal Management*, 106, 87-96, 2015) presents a study to monitor the socioeconomic impacts of the first extended closure of the western and central Pacific Ocean bigeye tuna fishery to longliners from the state of Hawai'i. They applied qualitative and quantitative approaches to examine how fishermen, the fish auction, dealers, processors, retailers, consumers, and support industries perceived and were affected by the 40-day closure of the bigeye fishery at the end of 2010. The analysis found there was reduced supply and quality of bigeye landed along with increased prices during the closure period. The overall impacts to members of the fishery community were not as severe as had been anticipated, but fish dealers were among those most affected. This study highlights the challenges and equity considerations inherent in efforts to achieve meaningful conservation benefits from localized management actions within a global fishery and demonstrates the value of socioeconomic monitoring to examine the impacts of these actions.
- An ecosystem approach is currently the dominant paradigm in fisheries management, whilst climate impacts present a pressing issue that fisheries managers must quickly organize to address. Until now, guidance on integrating the impacts of climate change and ocean acidification on coastal fisheries into an ecosystem approach has been lacking. Adel Heenan et al. ("A climate-informed ecosystem approach to fisheries management", *Marine Policy*, 57, 182-192, 2015) describes activities required to harness the full potential of the ecosystem approach to management framework as an adaptation tool to these inevitable but unclear impacts. This paper concludes that the need to address the projected effects of climate change and ocean acidification on coastal fisheries, and the expected availability of resources to assist developing countries in doing so, offer an opportunity to overcome some of the challenges that have so far impeded widespread implementation of an ecosystem approach to fisheries management.
- William Walsh and Jon Brodziak ("Model selection and multimodel inference for CPUE standardization for billfishes in the Hawaii-based pelagic longline fishery", *Fisheries Research*, 166, 151-162, 2015) presents catch per unit effort (CPUE) standardizations and model selection procedures for blue marlin, striped marlin, shortbill spearfish, sailfish, and swordfish caught in Hawaiian waters during 1995–2011. The catch data, collected by the NOAA Fisheries Pacific Islands Regional Observer Program (PIROP), consists primarily of zeros for all species. The analytical objective compares five types of generalized linear models for each

species, as they represent different hypotheses about the nature of the stochastic process of longline capture. The model selected for each species was a zero-inflated negative binomial, which was consistent with findings in an earlier study of the oceanic whitetip shark and supported a recommendation that this type of model be used for CPUE standardization for large oceanic pelagic fishes caught in low numbers (with many zeros).

- Much progress has been made in dynamic ecosystem model development for coral reefs. Mariska Weijerman et al. ("How models can support ecosystem-based management of coral reefs", *Progress in Oceanography*, in press) reviewed the approaches taken in these models classified as minimal, intermediate, and complex based on the leading principal and level of realism and process detail. Results highlight the importance of choosing an appropriate approach based on the type of questions to be answered. Minimal and intermediate models are valuable tools to assess the response of key states to main stressors and contribute to understanding ecological functioning. Complex models can be useful tools for quantitatively evaluating management scenarios. The best practice approach uses multiple model types and thus benefits from the strength of different model types.
- It is challenging to distinguish between natural and human-induced shifts in coral reef community organization. A better understanding is needed of the processes that drive dramatic shifts in coral reef ecosystems and their associated ecological thresholds or 'tipping points'. Jamison Gove et al. ("Coral reef benthic regimes exhibit non-linear threshold responses to natural physical drivers", *Marine Ecology Progress Series*, 522, 33-48, 2015) assessed the independent effects of natural drivers in structuring coral reef benthic communities at the remote Palmyra Atoll in the central equatorial Pacific. The results highlight the importance of natural gradients of physical drivers in determining dominant benthic regimes on coral reefs and non-linear thresholds (or tipping points) existing between benthic competitors in response to key physical drivers. The research also found that coral assemblages show inherent flexibility and can reorganize in response to physical drivers rather than exhibit wholesale changes in overall cover. In essence, reef communities respond non-linearly to the array of human and natural drivers. The subsequent challenge is to identify manageable drivers that would otherwise compromise key coral reef ecosystems services in the context of the unmanageable natural changes.
- The University of Hawaii Sea Level Center is the largest climate-related research program within JIMAR. UHSLC Associate Director Philip Thompson led a study using a unique cluster analysis approach to global sea level reconstructions (Thompson and Merrifield, 2014). They were able to show that not only is sea level rising faster in regions south of the equator compared to north over the past 20 years, but also that the trend asymmetry is unique over roughly the last century. Wind-forced volume redistribution is considered the likely source for the pattern. JIMAR also supported sea level research led by Dr. Matthew Widlansky of the IPRC. Widlansky et al. (2014) showed that the meridional sea level seesaw pattern associated with ENSO results in high amplitude sea level depressions in the Samoa region that lag peak El Niño events. These features are linked to a southward movement of weak trade winds and an anomalous anticyclone in the Philippine Sea. A nonlinear interaction between El Niño time scale variability and the annual cycle is the cause of this phenomenon.
- The Pacific ENSO Applications Climate Center (PEAC) was particularly active during the past year as El Niño conditions strengthened. PEAC researcher Dr. Rashed Chowdhury led a study to improve seasonal water level outlooks using regional winds as well as sea surface temperature patterns (Chowhury and Chu, 2015). PEAC is contributing to a new operational sea level forecast for the western Pacific.
- JIMAR provides administrative support for the Pacific Islands Ocean Observing System (PacIOOS) program, which disseminates products to the public that help to ensure a safe, clean, and productive ocean and a resilient coastal zone for the U.S. Pacific Islands. PacIOOS served information and data to over 215,000 unique individuals, totaling 1.25 million web page views on the pacioos.org website, and a total of 1.5 TB of data transferred during FY 2015. Operational wave and ocean modeling products, as well as wave run-up forecasts were expanded or refined to better serve the Marshall Islands and Hawai'i. PacIOOS continues to maintain over 30 deployed buoys, sensors, and other instruments throughout the U.S. Pacific Islands, including a new wave buoy in American Samoa and an expanded network of High Frequency Radar stations in Hawai'i. More than a hundred datasets (both PacIOOS and partner data) are available to the public through PacIOOS' data visualization platform 'Voyager' at http://pacioos.org/voyager.
- During FY 2015 JIMAR provided funding support for the 40th Albert L. Tester Symposium (April 8-10, 2015, University of Hawaii at Manoa), a symposium of student research papers covering a broad range of fields within marine biology. JIMAR also provided funding support for the PIFSC Young Scientist Opportunity (PYSO) 2015 summer intern program. The PYSO is a collaborative program between PIFSC and JIMAR that offers qualified participants professional scientific research experience and training under the mentorship of selected researchers of the PIFSC.

The Director of JIMAR is a regular member of the University of Hawaii faculty and is appointed through joint decisions by leaders of the University and NOAA Research. The Director reports to an Executive Board composed of University and NOAA officials. As both NOAA Research and University research ventures have grown, both agencies have delegated more responsibilities to the field. The Director of NOAA Research has delegated most decision-making authority to the Director of PIFSC. The President of the University has delegated his responsibilities as Chair of the Executive Board to the Chancellor of the Manoa campus. The Director manages day-to-day operations through the administrative staff (fully-supported by the Cooperative Agreement and returned indirect cost funds), Program Managers, and faculty PI/Directors. A Council, elected among the Fellows, advises the Director on major expenditures on visiting scientists and the selection of new and renewed Fellows. The list of current Fellows and Council members are provided. Owing to the long-distance nature of the NOAA/JIMAR relationship, no single meeting of all Fellows is possible. Business of both the Fellows and the Council are done via e-mail and by visits of the Director to NOAA facilities and professional meetings.

JIMAR Senior Fellows from NOAA are Dr. Christofer Boggs (PIFSC), Dr. Russell Brainard (PIFSC), Dr. Edward DiMartini (PIFSC), Dr. Gregory Johnson (PMEL), Dr. William Kessler (PMEL), Dr. John Marra (PRCS), Dr. Michael McPhaden (PMEL), Dr. Dennis Moore (PMEL), Dr. Frank Parrish (PIFSC), Dr. Jeffrey Polovina (PIFSC), Dr. Christopher Sabine (PMEL), Dr. Michael Seki (PIFSC), and Mr. Raymond Tanabe (NWS).

JIMAR Senior Fellows from the University of Hawaii are Dr. Gary Barnes, Dr. Steven Businger, Dr. Jeffrey Drazen, Dr. Eric Firing, Dr. Erik Franklin, Dr. Kim Holland, Dr. Roger Lukas, Dr. Douglas Luther, Dr. Margaret McManus, Dr. Anna Neuheimer, Dr. James Potemra, Dr. Brian Powell, Dr. Robert Toonen, and Dr. Bin Wang.

JIMAR Council Members from NOAA are Dr. Edward DiMartini, Dr. Christopher Sabine, and Dr. Michael Seki.

JIMAR Council Members from the University of Hawaii are Dr. Gary Barnes, Dr. Jeffrey Drazen, and Dr. Eric Firing.

Task I is the base program of JIMAR. It provides research support for the visiting scientist and post-doctoral programs, and the administrative support for the Institute. The University of Hawaii contributes to this task by bearing all indirect costs and paying the salary of the Director. Funding percentages by activity are shown in the following chart.



Distribution of JIMAR's Task I NOAA Funding by Activity

Distribution of NOAA Funding by Task (FY 2012-2015)



Distribution of NOAA Funding by Theme (FY 2012-2015)



Accomplishments for Fiscal Year 2015

Ecosystem Forecasting

Research under this theme leads to improved forecasting of the frequency and magnitude of ecosystem processes within the Pacific Islands region. JIMAR facilitates research in development of open source fisheries ecosystems modeling tools (Auto-Differentiation Model Builder) and marine population dynamics and fisheries stock assessment models.

ADMB Open Source Project

P.I: John R. Sibert

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Michael P. Seki

NOAA Goal(s):

- Resilient Coastal Communities and Economies
- NOAA Enterprise-wide Capabilities: Science and Technology Enterprise; Engagement Enterprise; Organization and Administration Enterprise

Purpose of the Project

The general purpose of the Auto-Differentiation Model Builder (ADMB) Open Source Project is to maintain and improve the ADModel Builder software package as free, open-source software. ADMB is currently used by all NOAA Fishery Science Centers to create stock assessment tools. Specifically, the project aims to: 1) improve and maintain software installation and manuals for end users; 2) improve software quality and more fully apply the ADMB coding standard; 3) enhance the software with new features to improve run time efficiency and model development; 4) improve long-term maintainability of the source code; and 5) upgrade previous generation C++ coding standards to modern C++ coding standards. The project maintains a long term goal to support the ADMB software through an active and committed group of users and developers located in laboratories and universities around the USA and the world.

Progress during FY 2015

During FY 2015, work continued on a number of ADMB Project priorities. Minor releases of the software, with improvements and fixes to the documentation, installation procedure, and source code were delivered in December 2014 (ADMB 11.2) and May 2015 (ADMB 11.3 and 11.4). The next major release (ADMB 12) is scheduled for 2016. Work on features for that release has been a key priority in this fiscal year. Specifically, development of support for parallel processing and thread processing to utilize the multi-CPU and multi-core features of modern computing hardware has progressed well. For example, substantial progress was made by Dr. Dave Fournier to implement a consistent interface for passing thread-specific data to and between running threads.

Other work during FY 2015 related to improvements in project infrastructure. Notably, the ADMB Project migrated many of its core services to GitHub, a widely used web-based server for hosting open source projects. Moving to GitHub enabled replacement of and improvements upon several services used by the ADMB Project. These services include the following.

- *Version control.* Previously managed with Subversion now successfully migrated to GitHub thereby preserving the full development history, which remains available for viewing. GitHub uses distributed (rather than centralized) version control, allowing developers to make changes independently of the master repository.
- *Issue tracking*. Previously managed by the ADMB Redmine issue tracker now managed via GitHub thereby linking issue tracking with access to the source code.
- *Software release*. Previously facilitated by the ADMB FTP service, now managed via Github, which includes a much needed feature to monitor download count statistics.

The following list of publications is non-exhaustive but attempts to capture a wide range of publications using ADMB software in 2014-15.

- Anderson, S.C., et al., 2014. ss3sim: an R package for fisheries stock assessment simulation with Stock Synthesis. *PloS One* 9(4):e92725.
- Biuw, M., J.U. Jepsen, J. Cohen, S.H. Ahonen, M. Tejesvi, S. Aikio, and R.A. Ims, 2014. Long-term impacts of contrasting management of large ungulates in the Arctic Tundra-Forest Ecotone: Ecosystem structure and climate feedback. *Ecosystems*, 17(5), 890-905.
- Correia, A. C., et al., 2014. Carbon sink strength of a Mediterranean cork oak understory: How do semideciduous and evergreen shrubs face summer drought? *Journal of Vegetation Science*, 25.2:411-426.
- Gazey, W. J., B.J. Gallaway, J.G. Cole, and D.A. Fournier, 2014. Accounting for fishing mortality when comparing density-dependent with density-independent mortality in Gulf of Mexico red snapper: Response to comment. *North American Journal of Fisheries Management*, 34(2), 352-358.
- Hohenstein, S., and R. Kliegl, 2014. Semantic preview benefit during reading. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 40(1), 166-190.
- Kell, L.T., G. Merino, P. De Bruyn, J.O. de Urbina, H. Arrizabalaga, and J.S.H. Murua, 2014. An example of conditioning an Operating Model using Multifan-CL. *Collective Volume of Scientific Papers-ICCAT*, 70(5), 2088-2095.
- Kitzes, J., and A. Merenlender, 2014. Large roads reduce bat activity across multiple species. *PloS One*, 9(5):e96341.
- Magnusson, A., 2014. Analysis of Greenland halibut (*Reinhardtius hippoglossoides*) CPUE using Pella-Tomlinson biomass models. Marine Research Institute, Iceland. Internal Report WD36.
- Miller, A.S., T.J. Miller, K. Mills, and T.F. Sheehan, 2014. Retrospective analysis of Atlantic salmon marine growth and condition in the northwest Atlantic based on tag-recovery data. *Fisheries Oceanography* 23(2), 103-115.
- Nielsen, A., and C.W. Berg, 2014. Estimation of time-varying selectivity in stock assessments using state-space models. *Fisheries Research*, 158, 96-101.
- Øigård, T.A., T. Haug, and K.T. Nilssen, 2014. From pup production to quotas: Current status of harp seals in the Greenland Sea. *ICES Journal of Marine Science: Journal du Conseil*, 71(3), 537-545.
- Øigård, T.A., and H.J. Skaug, 2014. Fitting state-space models to seal populations with scarce data. *ICES Journal of Marine Science: Journal du Conseil*, fsu195.
- Skaug, H.J., and J. Yu, 2014. A flexible and automated likelihood based framework for inference in stochastic volatility models. *Computational Statistics & Data Analysis*, 76, 642-654.
- Zimmerman, K., D. Levitis, E. Addicott, and A. Pringle, 2014. Maximizing the mean nearest neighbor distance of a trait to choose among potential crosses and design a fully crossed mating experiment. *bioRxiv*, 009720.
- Aires-da-Silva, A.M., M.N. Maunder, K.M. Schaefer, and D.W. Fuller, 2015. Improved growth estimates from integrated analysis of direct aging and tag–recapture data: An illustration with bigeye tuna (*Thunnus obesus*) of the eastern Pacific Ocean with implications for management. *Fisheries Research*, 163, 119-126.
- Brenden, T.O., J.R. Bence, W. Liu, I. Tsehaye, and K.T. Scribner, in press. Comparison of the accuracy and consistency of likelihood-based estimation routines for genetic stock identification. *Methods in Ecology and Evolution*, doi: 10.1111/2041-210X.12377.
- Hurtado-Ferro, F., C. Szuwalski, J.L. Valero, S. Anderson, C. Cunningham, K. Johnson, R. Licandeo, C. McGilliard, C. Monnahan, M. Muradian, K. Ono, K. Vert-pre, A.R. Whitten, and A.E. Punt, 2015. What generates retrospective patterns in statistical catch-at-age stock assessment models? *ICES Journal of Marine Science*. 72(1), 99-110.
- Goethel, D. R., C.M. Legault, and S.X. Cadrin, 2015. Testing the performance of a spatially explicit tagintegrated stock assessment model of yellowtail flounder (*Limanda ferruginea*) through simulation analysis. *Canadian Journal of Fisheries and Aquatic Sciences*, 72(4), 582-601.
- Jardim, E., C.P. Millar, I. Mosqueira, F. Scott, G.C. Osio, M. Ferretti, and A. Orio, 2015. What if stock assessment is as simple as a linear model? The a4a initiative. *ICES Journal of Marine Science: Journal du Conseil*, 72(1), 232-236.
- Johnson, K.F., C.C. Monnahan, C.R. McGilliard, K.A. Vert-pre, S.C. Anderson, C.J. Cunningham, F. Hurtado-Ferro, R. Licandeo, M. Muradian, S.K. Ono, C.S. Szuwalski, J.L. Valero, A.R. Whitten, and A.E. Punt, 2015. Time-varying natural mortality in fisheries stock assessment models: Identifying a default approach. *ICES Journal of Marine Science*, 72(1), 137-150.

- Siddeek, M.S.M., J. Zheng, A.E. Punt, and V. Vanek, in press. Estimation of size-transition matrices with and without molt probability for Alaska golden king crab using tag-recapture data. *Fisheries Research*. http:// dx.doi.org/10.1016/j.fishres.2015.04.013.
- Ono, K., R. Licandeo, M.L. Muradian, C.R. Cunningham, S.C. Anderson, F. Hurtado-Ferro, K.F. Johnson, C.F. McGilliard, C.F. Monnahan, C.S. Szuwalski, J.L. Valero, K.A. Vert-pre, A.R. Whitten, and A.E. Punt, 2015. The importance of length and age composition data in statistical age-structured models for marine species. *ICES Journal of Marine Science*, 72(1), 31-43.
- Stevenson, B.C., D.L. Borchers, R. Altwegg, R.J. Swift, D.M. Gillespie, and G.J. Measey, 2015. A general framework for animal density estimation from acoustic detections across a fixed microphone array. *Methods in Ecology and Evolution*, 6(1), 38-48.
- Wang, S.P., M.N. Maunder, T. Nishida, and Y.R. Chen, 2015. Influence of model misspecification, temporal changes, and data weighting in stock assessment models: Application to swordfish (*Xiphias gladius*) in the Indian Ocean. *Fisheries Research* 166, 19-128.
- Xu, X., E. Cantoni, J.M. Flemming, and C. Field, 2015. Robust state space models for estimating fish stock maturities. *Canadian Journal of Statistics*, 43(1), 133-150.

Ecosystem Monitoring

Observing systems and data management are integral to this theme. Significant efforts are undertaken in JIMAR to monitor and assess reef ecosystems, fisheries habitat and stocks, endangered marine animals, and threats to marine ecosystems. JIMAR contributes to the NMFS effort to continually monitor catch data from the fisheries industry across the Pacific Islands.

A Biogeographic Assessment of Reef Fishes, Fisheries, and Benthic Assemblages in Hawai'i

PI: Alan Friedlander

NOAA Office (of the primary technical contact): Biogeography Branch, Center for Coastal Monitoring and Assessment

NOAA Sponsor: Matt Kendall

NOAA Goal(s)

· Healthy Oceans

Purpose of the Project

Working with NOAA's Biogeography Program, the purpose of this project is to conduct a biogeographic assessment of reef fish and benthic assemblages in the Main Hawaiian Islands (MHI) to support Bureau of Ocean and Energy Management (BOEM) efforts to manage renewable energy activities in Hawai'i. The objectives for the assessment include: 1) characterizing the distribution of reef fishes and benthic assemblages found within the MHI; 2) identifying spatial and temporal data gaps; and 3) supporting marine spatial planning in the MHI. The assessment will help in defining the biogeographic distribution of fishes across the MHI with the intended goal of developing a biogeographic framework to examine natural and anthropogenic factors that influence the patterns of reef fish distributions and benthic assemblages across one of the most unique and isolated marine ecosystems on Earth. This assessment will also help support ecosystem-based management and marine spatial planning of the MHI by multiple federal agencies.

Progress during FY 2015

A total of seven tasks were outlined for the entire two-year study and the following tasks were accomplished in FY 2015. The first task was to identify and acquire existing data on fish and benthic assemblages in the Hawaiian Archipelago. This task was completed, resulting in a database of 5,378 unique geographic surveys spanning the entire archipelago. The second task was to organize the datasets into a common GIS framework and identify

informational gaps in existing datasets and research activities. The project successfully created a geodatabase of all existing data, including a comprehensive spatial dataset of habitat predictors derived from remote sensing sources. The third task was to synthesize GIS data to create complete data layers that span the study area, and the fourth task was to conduct spatial analyses to identify biogeographic patterns and ecologically important regions. The project is currently undertaking these tasks and developed spatially predictive models for three response variables identified by NOAA and BOEM collaborators as important. All work so far has been on schedule and research staff has not encountered any roadblocks.

Bio-Sampling

PI: Mark A. Merrifield [JIMAR Project Lead: Brett Taylor]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Michael P. Seki, Robert Humphreys

NOAA Goal(s)

· Healthy Oceans

Purpose of the Project

This JIMAR project conducts research on marine species that represent major food and cultural resources to the Pacific Islands Region. The project aims to provide scientific advice to those charged with the management of the resources as mandated by legislation (e.g., Reauthorized Magnuson Stevens Act, Marine Mammals Protection Act, Endangered Species Act, etc.). The primary objective of the Life History Program (LHP) and the JIMAR Biosampling project is to conduct fundamental biological and ecological research on harvested marine species, provide new or improved estimates of life history parameters (length-at-age growth curves, longevity, size at median maturity, spawning season, length-weight relations), and improve and support the biological data needs of ongoing and future stock assessments of fishery resources in Hawai'i and the Pacific Island Territories.

Progress during FY 2015

To fulfill the primary objectives of the LHP, the project continued to conduct biological studies aimed at improving knowledge of life-history parameters utilizing specimens collected in the central, south, and western



Figure 1. Image shows the (A) histological features of a mature female Pristipomoides filamentosus; presence of vitellogenic (Vtg1, Vtg2, and Vtg3) oocytes, germinal vesicle migration (GVM), and yolk envelopment (B) histological features of a mature male Pristipomoides filamentosus; presence of numerous spermatozoa (Sz) (tailed sperm) in the sinus system with abundant tailed sperm in fully developed sperm crypts.



Bottomfish & Coral Reef Fish Caught in the Northern Mariana Islands Biosampling Project SE-14-04 June-July 2014

Figure 2. Fork length frequency graphs of the twelve most frequently caught species in the Northern Mariana Islands during the June-July biosampling project (SE-14-04) targeting bottomfish and coral reef fish species important to local resource agencies in CNMI and Guam. For each fish, otoliths and gonads were extracted and length and weight measurements were obtained.



Figure 3: Photomicrograph of a transverse section of a sagittal otolith of an orangespine unicornfish (Naso lituratus), a popular food fish from the Commonwealth of the Northern Mariana Islands, prepared by biosampling staff at PIFSC. White marks denote annual increments.

Pacific regions. To this end, JIMAR Biosampling staff: 1) participated in bottomfish sampling operations around the MHI and the Northern Mariana Islands (SE-14-04) collecting bottomfish and coral reef fishes; 2) processed incoming Deep-7 bottomfish or coral reef fish for hard parts and tissues; 3) conducted seasonal sampling of the Deep-7 bottomfish for reproductive organs (gonads) in Maui; and 4) conducted site visits to the western Pacific territories to assess biosampling efforts. Collected specimens continue to be appropriately labeled, preserved, and archived; associated specimen data (and metadata) is organized, analyzed, and managed in an efficient manner in R, Excel, and Access.

Other project activities included: 1) identification of the sex and maturation phase of 580 opakapaka (*Pristipomoides filamentosus*) using histological slides of gonadal tissue; 2) creation of maturity ogives and estimates of median size at 50% maturity for male and female opakapaka using R statistical software; 3) accessed spatial and temporal grids of NOAA oceanographic data through Environmental Data Connector to enhance data visualization and analysis; and 4) used ImageJ software to process and display microscopic images of oocyte and sperm development.

In addition to the proposed objectives for fiscal year 2015, two peer-reviewed publications stemming from biosampling efforts were published during the project period. Both covered topics relating to parrotfish fisheries in the Marianas and greater Micronesia. Also, the processing and interpretation of coral-reef fish otoliths and gonads began in early 2015 and to date well over 1500 specimens across several species from the Pacific territories and Hawai'i have been completed at PIFSC. This work will continue as a priority in the next fiscal year.

Database of Marine Cultural Heritage Artifacts Offshore within the Hawaiian Islands

P.I.: Alexander Shor

NOAA Office (of the primary technical contact): Office of National Marine Sanctuaries

NOAA Sponsor: Hans Van Tilburg

NOAA Goal(s)

• NOAA Enterprise-wide Capabilities: Science and Technology Enterprise; Engagement Enterprise; Organization and Administration Enterprise

Purpose of the Project

The Hawai'i Undersea Research Laboratory (HURL) at the University of Hawai'i has carried out hundreds of submersible dives off Oahu, Hawai'i, Maui, Molokai, Kauai, and Lanai. During those operations, they gathered visual, photographic, and sonar documentation of numerous anthropogenic artifacts on the seafloor, many of which have historical or cultural significance. NOAA's Office of National Marine Sanctuaries is collaborating with the Bureau of Ocean Energy Management in a program to establish a database of the locations and types of significant archeological and cultural resources that lie within the regions over which BOEM has jurisdiction for the planning of offshore renewable energy development. The purpose of the project is to transfer records held by HURL related to such resources to NOAA, putting data into the Access database format that they are using, and providing metadata and links to archived data at University of Hawai'i that document these important observations.

Progress during FY 2015

A total of 180 artifacts were added to the Database of Marine Cultural Heritage Artifacts Offshore. Of these artifacts, all included positions except for four. Two of these were proprietary (non-disclosure) positions and the other two were historical updates of vessels already listed in the database but had no background information. Of the 176 artifacts with positions, 166 were level 1 (highest level of 5) in accuracy of location. Nine of the remaining ten were level 2 in accuracy, meaning the position wasn't taken right next to the artifact but the position could be easily estimated with a relatively close degree of accuracy and could likely be relocated again. The remaining artifact is a historically significant vessel that has not yet been located but has a "target" location based on survey data and is a level 4 position.

Of the 180 artifacts a total of 164 were discovered, surveyed, and, in many cases, identified by HURL. It should be noted that in some cases vessels have been found in multiple portions. HURL generally considers each portion as an individual artifact if they are considerably different in location or found on different dives (as is the

case with all of the Japanese submarines). Smaller portions of airplanes such as lone wings and engines are also entered as individual artifacts. The 164 HURL artifact entries are categorized as follows: Aircraft–26; Landing Craft–37; Submarines–15; Ships, Boats, and Barges–23; and Vehicles–63.

Sixteen more artifacts that were entered into the database were not discovered by HURL submersibles. Thirteen are from shallower sites, which were not common to scuba divers or well-known by the public. Neither their locations nor their background information is available in other databases. In some cases these items have been researched extensively by HURL. The three items remaining are ships whose locations are unknown and are historical updates on existing entries that were largely lacking in data. The entries are as follows: Aircraft (wing)–1; Landing Craft–3; Submarines–0; Ships, Boats, and Barges–7; and Vehicles–5.

Ecosystem Modeling

P.I.: Mark A. Merrifield [JIMAR Project Lead: Melanie Abecassis]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Michael P. Seki, Jeffrey J. Polovina

NOAA Goal(s)

· Healthy Oceans

Purpose of the Project

This JIMAR project uses previously-acquired tag data from two species of cetaceans and collects insitu oceanographic and acoustic data to build habitat models, and revise and improve an ecosystems model (Ecopath with Ecosim) for the North Pacific longline fishing grounds. In addition, the project is tasked with participation in NOAA research cruises in the North Pacific Transition Zone Convergence Front (TZCF) region and works to analyze previously collected acoustics data to provide a better understanding of the forage biomass in various areas of the North Pacific Ocean.

Progress during FY 2015

Data from 58 satellite tags deployed on shortfinned pilot whales (n=46) and Blainville's beaked whales (n=12) provided by the Cascadia Research Collective were analyzed to compute cetacean density maps. Generalized additive models were built to characterize the relationships between cetacean presence, micronekton presence and oceanographic variables off the west coast of Hawai'i Island. Additionally, active acoustics data collected in the same area during three research cruises onboard a NOAA research vessel showed evidence of a deep mesopelagic boundary layer community believed to be key to a food web that supports insular cetacean populations. A manuscript has been submitted to PLOS ONE and is in review (Abecassis et al., in review).



Figure 1. Observed pilot whales (top) and beaked whales (bottom) kernel density from tag data (color scale) overlaid with bathymetry contours (white lines) and surface current direction (black arrows. Size of the arrow is proportional to current strength). Tag deployment locations are represented by green triangles.



Figure 2. Observed density of micronekton along 2011, 2013, 2014 cruise transects (a–c, respectively), all three cruises combined with a "hotspot" and an "off-shore" site circled (d) and corresponding predicted density of micronekton over the study area from a Generalized Additive Model (long,lat) (e). Values shown here are standardized relative biomass values observed at the 70 kHz frequency in the deep layer (375-675 m) during the night-time. The lettered black dots in (b) represent the 2013 trawling stations.

A formal agreement was reached in 2012 with the SPC (Noumea, New Caledonia) to obtain an exhaustive fishing dataset for non-U.S. longline fleets in the Pacific Ocean to revise the adaptation of the SEAPODYM model to swordfish that was undertaken in 2011 (Abecassis et al., 2011). However, issues with one of the data partners have prevented this project from going forward.

JIMAR staff helped with planning, organizing and abstract review for the NOAA IEA Symposium on Kona's (West Hawai'i) Marine Ecosystem: Trends and Status, held September 4-5, 2014, in Kona, HI. The purpose of this two-day symposium was to provide a forum for scientists and managers to present and discuss information pertaining to the coastal marine ecosystem of West Hawai'i. An important focus was to identify key time series information that can serve as indicators of ecosystem state. Subsequently, JIMAR staff have been involved in analyzing oceanographic and marine mammal sightings datasets to be used as ecosystem indicators for the Kona IEA "ecosystem trends and status" report (in preparation).

JMAR staff led active acoustics operations and assisted with CTD and mid-water trawling operations during a NOAA research cruise in April 2015 to study the TZCF region during an El Niño year. JIMAR staff were also involved in analyzing remote sensing data to identify trends and patterns in chlorophyll concentration, primary productivity, sea surface temperature, sea surface height, and currents speed since 1998. This work will yield a journal publication with a JIMAR co-author.

Additionally, JIMAR staff analyzed active acoustics data from past NOAA research cruises and assisted in packaging acoustics data collected in 2013-2015 to fulfill NOAA's requirements for Public Access to Research Results (PARR).

Finally, JIMAR staff successfully updated a working central North Pacific Ecopath with Ecosim ecosystem model for the area of the Pacific utilized by the Hawai'i longline fleet. Specifically, results from recent diet studies were incorporated to expand the representation of the lesser known non-target fish species (e.g., lancetfish, opah, snake mackerel) and nine mid-trophic micronekton functional groups. An energy budget for the ecosystem was constructed to simulate how changes in the various micronekton functional groups impact apex predator production, which helps to highlight the importance of different energy pathways from lower trophic level

animals up to commercially harvested apex predators. Simulated ecosystem changes resulting from changes to micronekton food web components demonstrated that crustacean and mollusk functional groups are the most important direct trophic pathways to the top of the pelagic food web. A manuscript is almost finalized and will be submitted to the *Marine Ecology Progress Series* (Choy et al., in preparation).

Ecosystems Observations Research Program

P.I.: Mark A. Merrifield [JIMAR Project Lead: Kyle Koyanagi]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Michael P. Seki

NOAA Goal(s)

· Healthy Oceans

Purpose of the Project

This JIMAR project monitors and conducts research on ecosystems that involve marine species and resources of concern to the Pacific Islands Region. The project activities enable scientists to provide advice to those charged with management of the resources as mandated by legislation (e.g., Reauthorized Magnuson Stevens Act, Marine Mammals Protection Act, Endangered Species Act, etc.). Current activities include: analysis and facilitation of Geographic Information System (GIS) databases of fisheries and habitats; data management of fisheries and ocean observations; support to advance public awareness of marine ecosystems and observations; field support for bottomfish research; and facilitation of deep-sea coral and sponge research. Several subprojects are reported here.

Marianas Trench Marine National Monument Pilot Mapping Project. This project is creating a pilot web browser-based geographic information system (GIS) mapping tool for the Marianas Trench Marine National Monument (MTMNM). In addition, the project serves as a test case to effectively integrate coral reef monitoring data, fisheries cruise survey data, and site-specific data collected by local agencies. The long-term goal is to have a web mapping tool serve as a repository and data dissemination tool for geospatial data collected by the Pacific



Figure 1. An example of the web map application interface for a draft version of the MTMNM web-based map viewer.

Islands Fisheries Science Center (PIFSC) and local agencies in the region. The expected products associated with this project include: 1) a database of PIFSC and select Monument geospatial data; 2) a series of web-accessible data layers (map services) created from the standardized database; 3) metadata describing all data within the database; 4) an interactive browserbased GIS mapping application; and 5) a simple user guide for the mapping application.

Fishing Ecosystem Analysis Tool (FEAT). Fishing Ecosystem Analysis Tool (FEAT) is a tool that queries and analyzes commercial fish catch information along with socioeconomic data from the 2000 U.S. Census, and outputs the results in multiple GIS formats. It was originally developed by the PIFSC and Makai Ocean Engineering, Inc. in 2010. The 2010 version was developed using software and server systems that did not integrate well with PIFSC ITS infrastructure and security requirements. The goal of



Figure 2. An example of the output products available from FEAT. Shown here is a summary of pounds caught (all gear and all species, 1996-2014) per fish reporting grid, license holder zip code, and port of landing.

this project is to redevelop the tool using software that is more accessible and easily integrated with PIFSC systems.

Science Operations Division-Advanced Sampling Technologies Program. Two objectives are identified for the JIMAR Science Operations Division-Advanced Sampling Technologies Program (SOD-ASTP). The first objective is the delivery of stereo-video data to the PIFSC Fisheries Research and Monitoring Division-Stock Assessment Program (FRMD-SAP) for the development of size-structured abundance estimates of bottomfish in the MHI. These abundance estimates are used in bottomfish stock assessment reports and other fisheries research. The second objective is the development of advanced technology assets such as the Modular Optical Underwater Survey System (MOUSS), Autonomous Underwater Vehicle (AUV), and Remotely Operated underwater Vehicle (ROV) to ensure operational readiness for use in future coordinated bottomfish surveys and other fisheries research endeavors.

Aquaculture System Management. The project provides system management for the SeaWater System (SWS) facility at the Inouye Regional Center on Ford Island to support research of marine species of concern to the Pacific Island Region. This includes working closely with federal and University partners in coordinating, developing, modifying, and maintaining the captive care facility for research, culture, and rehabilitation for marine species.

Focus Habitat Studies Report. This JIMAR project provides technical support to researchers and collaborators to conduct research on focus habitats within the U.S.-affiliated marine national monuments of the Pacific (Pacific Remote Islands, Marianas Trench, and Rose Atoll). Focus habitats in this context are an aggregation of generally understudied yet ecologically important habitats such as nursery areas, transitions zones, and other ecotones between larger habitat study areas. This project supports the development of new methodologies to effectively survey such focus habitats and collection of descriptive data that will serve to establish critical baselines, document responses, as well as characterize the ecological importance of such habitats.

Pacific Islands Deep Sea Coral and Sponge Initiative. The PIFSC is responsible for the survey and assessment of deep water corals and sponges throughout the U.S. Western Pacific Region. With support from the NOAA Deep Sea Coral Research and Technology Program (DSCRTP), JIMAR developed the Pacific Islands Deep-Sea

Coral and Sponge Initiative (PICSI). This three-year program seeks to advance knowledge of deep-sea corals and sponges in the U.S. Pacific Islands in order to improve the management of these important resources. A research prioritization workshop identified the need to use existing datasets to conduct an analysis to inform decisions on future work. One of the two datasets identified was from a series of research submersible dives conducted in 2005 by the University of Hawai'i's Undersea Research Laboratory (HURL) in American Samoa and Line Islands. The objective of the project for the report period was to annotate video data from these dives with information on the taxonomic identification of deep sea corals and other cnidarians, sponges, and characteristics of the habitats where they were observed. A second component of the work was to then format the observational records so that they could be ingested into the DSCRTP's database of deep sea corals and sponges throughout U.S. waters.

Progress during FY 2015

Marianas Trench Marine National Monument Pilot Mapping Project. Significant progress was made during FY 2015 towards development of the MTMNM web-based mapping tool. At the time of this report the following tasks were completed.

- A draft version of the database was created containing a subset of the PIFSC geospatial data holdings.
- Web-based map services were created for distribution and sharing of the data.

• Draft versions of interactive web map viewers have been created that allow users to view, analyze, and download the data.

Fishing Ecosystem Analysis Tool (FEAT). During FY 2015 significant progress was made towards creating an updated and accessible version of FEAT. Specific accomplishments include the following.

- An updated version of the FEAT database was compiled, which includes all records (1996-2014) from Hawai'i Division of Aquatic Resources Reported Commercial Marine Landings database.
- Using the Python programming language, a script tool was developed to automate the FEAT workflow. This involves querying the database based on user provided criteria (gear types, date range, fishing location, species targeted, etc.) and creating GIS products summarizing the pounds of fish caught per fishery reporting grid, port

of landing, and angler zip code. The Python script has been integrated into a shareable ArcGIS Toolbox that can be run from within ArcGIS Desktop software.

 The newly developed FEAT tool was used in support of ongoing PIFSC/ JIMAR investigations looking at potential interactions between commercial fishing activities and endangered species (Hawaiian monk seal and false killer whale) in Hawaiian waters.

Scientific Information Services. The JIMAR Scientific Information Services project provides technical support to PIFSC and JIMAR staff on various aspects of data services, including management of quality controls and timely data entry of Hawai'i and American Samoa longline fishery logbook data that are loaded and made available through the PIFSC Oracle enterprise database. An estimated 19,500 longline logsheets were entered for the project year. Project staff began receiving American Samoa longline logbooks from the Department



Figure 3. Above is an example of the types of analysis enabled by FEAT. Shown here is a summary/comparison of the gear types being utilized in waters adjacent to Hawai'i Island.

of Marine and Wildlife Resources (DMWR) during the project year. Project staff also received, prepared, and completed data entry of: 1) deepwater shrimp catch and sales data; 2) precious corals catch and sales data; and 3) Saipan bottomfish catch and sales data. In addition, the project personnel maintained the Fisheries Data Catalog, which runs on the Drupal Content Management System (CMS). The Fisheries Data Catalog is a web-based listing of PIFSC fisheries and research data holdings that include summaries of essential metadata and related literature such as code lists, log sheets, and field specifications.

Science Operations Division-Advanced Sampling Technologies Program. During the first quarter of FY 2015, SOD-ASTP Insular Fisheries Research Specialists addressed the first objective of the 2015 fiscal year by completing video analysis of the remaining stereo-video recordings taken on both the Bottom Camera Bait Station (BotCam) and SeaBED Autonomous Underwater Vehicle (AUV) platforms during MHI gear calibrations cruises. Sizestructured abundance data was delivered to the PIFSC Stock Assessment Group for BotCam surveys and AUV stereo-video surveys. Cruise planning and preparations are underway for an October effort to survey MHI bottomfish populations using the Modular Optical Underwater Survey System (MOUSS). In the last quarter of FY 2015, SOD-ASTP video analysts also provided support for Guam Baited Remote Underwater Video Station (BRUVS) video annotation.

SOD-ASTP staff embarked on two training missions during FY 2015: AUV long baseline training and EK60 calibration training. The majority of project time for the SOD-ASTP team was dedicated to the development and utilization of the MOUSS technology as it was identified as an integral part of island-wide bottomfish surveys. The



Figure 4. MOUSS field trials on NOAA 19-foot safe boat, Steeltoe, with MOUSS sample imagery superimposed.



Figure 5. MOUSS-BotCam tandem system assembled for comparative stereo-camera tests.

utilization of the MOUSS technology required time for system assembly, calibration, testing, gear procurement, small boat modifications, risk assessment, protocol documentation, and cruise planning. Within the project year, six MOUSS units were assembled, calibrated, and field tested. With the long-term MOUSS project goal of using cooperative fishing vessels as platforms for operations, field trials were held using a NOAA 19-foot safe boat outfitted with a pot hauler. The successful deployment and recovery of the MOUSS system off of a 19-foot vessel and successful imagery collection were key milestones in moving forward with the MOUSS technology. Towards the end of FY 2015, MOUSS-BotCam tandem deployments were done to ensure that fish data collected by the two stereo-camera technologies was comparable as the MOUSS is slated to replace the older analogue BotCam system.

Aquaculture System Management. During the project year, JIMAR staff provided support for the SWS facility by incorporating a weekly exercise of each system and a monthly equipment maintenance schedule to ensure system readiness for incoming animals in the four distinct units (monk seal, turtle, fish, and multi-purpose). Structures covered with shade cloth were built and placed around pumps and sand filters to help minimize the wear and tear effects of UV sun rays. Modifications to the maintenance schedule were implemented to make operations run more smoothly. Turtle staff members were trained in system operations and aided with the help of new labels on pipes indicating function and flow direction. During this period, JIMAR staff provided facility support for seven monk seals, eleven injured or sick turtles, fourteen underwater video camera calibrations, and acoustic testing for the cetacean project group. When animals are housed at the SWS facility, JIMAR staff provided 24/7 emergency support through email alarms and remote control of cameras and the Supervisory Control and Data Acquisition (SCADA) system.

Focus Habitat Studies Report. The PIFSC CRED staff conducted two Pacific RAMP surveys aboard the NOAA Ship Hi ialakai in the PRIAs of Baker, Howland, Jarvis, Johnston Atoll, Kingman Reef, and Palmyra Atoll and the Rose Atoll Marine National Monument. Both surveys focused on ecological monitoring of fish assemblages to produce estimates of mean total fish biomass as well as characterize associated benthic communities. Both the PIFSC Cetaceans Research Program (CRP) and Ecosystems Oceanography Division (EOD) conducted research projects aboard the R/V OES in the Mariana Trench National Monument. The CRP completed a whale and



Figure 6. A recovering monk seal at pool side at the NOAA SWS facility on Ford Island.



Figure 7. PIFSC staff retrieving a ring net in the Mariana Islands during the Kona crab survey conducted by EOD. Photo taken by Laren Van Heukelem.

dolphin abundance survey using passive acoustic technology and visual observers, and EOD completed a Kona crab survey by deploying sardine-baited ring nets into habitat thought to be ideal for Kona crab.

Fishery Data Management and Spatial Data Analysis. During the project year, JIMAR staff:

- Continued maintenance, updating, and administration of ArcGIS map services, web-based applications, and back-end enterprise geo-database for the spatial information repository for display, access, and distribution of spatial data.
- Participated in the South Pacific Tuna Treaty (SPTT) Purse Seine Database Development and Migration project, and worked closely with the Southwest Fishery Science Center (SWFSC) and PISFC data management teams in the development of SPTT data model, database, data entry, and data report.
- Continued spatial analysis and statistical analysis of fishery and ecosystem data to facilitate timely reporting of
 information to stakeholders and Regional Fishery Management Organizations (RFMOs), including the Annual
 Fisheries Statistics and Data Report of the U.S. Longline Fisheries, annual data report to the Western and
 Central Pacific Fisheries Commission (WCPFC), International Scientific Committee for Tuna and Tuna-like
 Species in the North Pacific Ocean (ISC), and Inter-American Tropical Tuna Commission (IATTC).
- Provided data management guidance and database design assistance to the projects in accordance with the PIFSC Data Management Policy.
- Worked as the PIFSC IT Helpdesk system administrator, and collaborated with the PIFSC IT Helpdesk team in daily IT support.



Pacific Islands Deep Sea Coral and Sponge Initiative. Dr. Chris Kelley of the Hawai'i Undersea Research Laboratory (HURL) at the University of Hawai'i completed a review of video data from American Samoa and the Line Islands during a series of dives conducted in 2005. Video imagery from the dives was annotated to create records in HURL's Video Annotation and Reference System (VARS) database and record names of cnidarians and sponges encountered as well as observations of environmental characteristics for dives at Palmyra Atoll, Kingman Reef, Jarvis Island, Rose Atoll and Taema Bank off Tutuila. Results were extracted and linked with navigational data so that each observation is associated with both a specific frame capture from the video and its associated geographic position. Results were then reformatted to make them compatible with the format utilized in the DSCRTP's database before being submitted to the DSCRTP.

Figure 8. Map of one of the regions surveyed during the Pacific RAMP project conducted by CRED.



Figure 9. A gold coral, Kulamanamana haumeaae, being collected in the region by a Pisces submersible operated by the Hawai'i Undersea Research Laboratory.



Figure 10. A white sea fan, Paracalyptrophora hawaiiensis, one of many species of deep sea coral encountered on submersible dives during the 2005 HURL cruise to American Samoa and the Line Islands.

Fisheries Monitoring and Support

P.I.: Mark A. Merrifield [JIMAR Project Lead: Walter Machado]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands **Fisheries Science Center**

NOAA Sponsor: Michael P. Seki, Keith Bigelow

NOAA Goal(s)

· Healthy Oceans

Purpose of the Project

This JIMAR project works to provide Pacific Islands Fisheries Science Center (PIFSC) with timely and accurate Fishery Management Plan (FMP) logbook data and other fishery information for use in research and management towards the goal of maintaining a healthy ocean that provides for a resilient and economically sound community. The main focus of the work is the daily monitoring of Hawai'i's pelagic longline fleet, which is presently and increasingly subject to international management at the species level. The project provides PIFSC and the fishing industry a contact point for feedback and information exchange with fishery scientists and managers.

Progress during FY 2015

The JIMAR Fisheries Specialist continues to provide Figure 1. Checking on longline catch at United Fishing timely high level support to fishery monitoring activities by



Agency.

providing high quality fisheries data to NMFS, PIFSC, and other JIMAR projects. The daily burden of quality control and processing logbook data has increased due to fast-tracking procedures, which were implemented to monitor Hawai'i's bigeye tuna (BET) landings. This information is used in forecasting landings to predict possible closure dates of the Hawai'i longline BET fishery if the Western and Central Pacific Fisheries Commission (WCPFC) and Inter-American Tropical Tuna Commission (IATTC) annual quota is predicted to be reached. The fast track monitoring was expanded to include striped marlin due to stock concerns. The additional monitoring

requirement increases the daily workload and are compiled weekly or as necessary as the quota gets taken. Additional quality control procedures and cross checks of relevant data bases have been implemented as needed to continually improve the results and timeliness of the product. As an example, a matching program comparing the longline logbook tuna counts to sales records at the United Fishing Agency auction was developed and is now used to improve the quality of the data. The general Hawai'i longline fleet-wide quarterly reports are completed 45 days after the end of the quarter. The logbook scanning and archiving project is ongoing and will now be including the American Samoa longline logbooks.

A photo database of Hawai'i's pelagic longline fishing fleet has been continually updated throughout the year and is used to document the fleet on an ongoing basis.

The PIFSC longline electronic reporting initiative funded by the Western Pacific Regional Fishery Management Council (WPRFMC) is in progress. The electronic reporting system, which uses handheld tablets to record logbook information, is at the step of testing and certification by PIFSC and JIMAR staff. During this process, and after approval of the application additional duties for JIMAR staff in terms of distribution of tablets, tablet reporting application training of captains and new internal procedures to deal with the transition to collecting and editing the electronic forms will be necessary.



Figure 2. Large bigeye tuna caught by a Hawai'i longline vessel.

Investigation of Ecological Constraints for Bumphead Parrotfish

P.I.: Mark A. Merrifield [JIMAR Project Lead: Meagan Sundberg]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Michael P. Seki, Robert Humphreys

NOAA Goal(s)

· Healthy Oceans

Purpose of the Project

The principal activity under this JIMAR project was to conduct an abundance survey of juvenile bumphead parrotfish (*Bolbometopon muricatum*) in the interior lagoon at Wake Island. Some geographical locations are devoid of young *B. muricatum*, yet these same areas maintain large numbers of adult fish; this anomaly had yet to be investigated at Wake Island. Among the U.S. jurisdictions where bumphead parrotfish are found, Wake Island represents the highest density of adults in U.S. waters. The survey results were intended to confirm or reject bumphead parrotfish presence in the lagoon, provide a better understanding of the dynamics of settlement and recruitment of this species, and provide a quantitative description of their nursery habitat.

Progress during FY 2015

A four-member team conducted a 12-day survey of the lagoon at Wake Island in June of 2013. No juvenile bumphead parrotfish were found during the snorkel surveys of the lagoon and only five adult bumphead parrotfish were spotted. This lack of survey data presented substantial obstacles to identify and characterize the ideal juvenile bumphead parrotfish habitat. The scarcity of adults was expected considering they usually frequent deeper water; however the lack of juveniles was surprising. Because of its remoteness, it was hypothesized Wake Island was primarily self-seeding. It is, however, too premature to conclude that juvenile bumphead parrotfish are completely devoid from the lagoon and surrounding waters because much of the lagoonal habitat and all of Wilkes Island has yet to be explored.

Project activity has been suspended in order to re-assess priorities on development of findings and potential alternative avenues for exploration.

Main Hawaiian Islands Deep 7 Bottomfish Fast Track Project

P.I.: Mark A. Merrifield [JIMAR Project Lead: Jessica Miller]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Michael P. Seki, Kimberly Lowe

NOAA Goal(s)

· Healthy Oceans

Purpose of the Project

The Main Hawaiian Islands (MHI) Deep 7 Bottomfish Fast Track Project is an ongoing JIMAR project that began in September 2007. The Annual Catch Limit (ACL) system was implemented by NOAA Fisheries in the State of Hawai'i to manage sustainable harvest of the "Deep 7" bottomfish species caught near the main Hawaiian Islands. The Deep 7 complex is comprised of six eteline snappers and an endemic grouper, known locally as onaga (Etelis coruscans), ehu (Etelis carbunculus), opakapaka (Pristipomoides filamentosus), kalekale (Pristipomoides sieboldii), gindai (Pristipomoides zonatus), lehi (Aphareus rutilans), and hapu'upu'u (Hyporthodus quernus). Hawai'i Revised Statutes require commercial fishers to submit their monthly fishing reports within ten days following the month in which marine life was taken. The Department of Land and Natural Resources-Division of Aquatic Resources (DLNR-DAR) implemented a new Administrative Rule on September 1, 2011, requiring commercial fishermen who catch Deep 7 species to submit trip reports within five days of their trip end date. JIMAR staff work in collaboration with DLNR-DAR to fast-track Deep 7 bottomfish fishing and dealer data in order to successfully monitor the fishery. The fishing year for the Deep 7 Bottomfish fishery opens annually on September 1st and closes either when the total landings are predicted to reach the ACL or on August 31st (whichever occurs first). Near real-time monitoring is needed to close the fishery before the ACL is reached, without exceeding this limit, so data collection and processing must be fast-tracked to provide timely and accurate landings information to assist in the monitoring and management of this fishery.

Progress during FY 2015

The project continued to successfully fast track data for the MHI Deep 7 bottomfish fishery. JIMAR staff met this objective through accurate and timely data entry, quality control cross checking between fishermen and dealer reported data, and outreach to both reporting parties to resolve discrepancies. In order to facilitate timely submittal, monthly reminder letters were mailed to Deep 7 dealers. Fishers who submitted late trip reports received citations from DLNR-DAR for violating the state law requiring fishers to submit their Deep 7 Bottomfish trip reports within five days of their trip end date.

As of June 19, 2015, 2,553 Deep 7 trip reports have been submitted for the 2014-2015 fishing year, while 6.5% were issued violations for late submissions. The compliance rate improved, as last year at the close of the season 9% of trip reports were issued violations due to late submissions. The data processing speed of the JIMAR staff



Figure 1. This graph shows the accumulation rate for the ACL during the current 2014-2015 MHI Deep 7 bottomfish fishing year (effective date June 18, 2015).

is to enter commercial fishing and dealer data within two days of receiving the report and a second staff member proofs the data that were entered.

The data quality control procedures involve using computer database applications developed by the Pacific Fisheries Science Center (PIFSC) Western Pacific Fisheries Information Network (WPacFIN.) The fisheries data were error checked on a daily basis and weekly summary updates were sent to fishery managers beginning in September 2013. Error analysis reports containing discrepancies between fisher and dealer reports were created monthly and the report records were rectified by contacting fishers and dealers for corrections. JIMAR staff members generally follow up with dealers within three days to correct any questionable or incorrect data and up to one month with fishers for trip reports submitted online or through mail. As part of the project's outreach efforts, newsletters were mailed to active Deep 7 bottomfishers in June 2015 to update them on the progress of the fishery.

2013–2014 Fishing Year. The 2013-2014 Deep 7 bottomfish fishery opened on September 1, 2013. In June 2013, the Western Pacific Regional Fishery Management Council (WPRFMC) recommended managing the 2013-2014 fishing year with an ACL of 346,000 pounds, the same as during the past two years. This ACL was posted in the Federal Register by NOAA Fisheries in September 2013. The Annual Catch Target (ACT), used to manage the fishery over the last two years, is no longer necessary because management's concern over the uncertainty of exceeding the ACL has been eliminated due to the trip report requirement and high compliance rate, supported largely by fast track monitoring and outreach. The 2013-2014 MHI Deep 7 bottomfish fishery remained opened for the full year, closing on August 31, 2014. During the fishing year, 423 fishers made 3,174 fishing trips and reported landing 89.7% of the 2013-2014 ACL.

2014–2015 Fishing Year. The 2014-2015 Deep 7 bottomfish fishery opened on September 2014 without an ACL. The WPRFMC would recommend an ACL based on the new 2014 Bottomfish Stock Assessment Report compiled by the PIFSC. However, a peer review conducted by a panel of Center for Independent Experts (CIE)

concluded that the report was not ready for management use. Federal fisheries management used the 2011 Bottomfish Stock Assessment Report as the best available information and decided to use the same ACL of 346,000 pounds for the 2014-2015 year. As of June 19, 2015, 280,881 pounds of Deep 7 Bottomfish landings were reported, which represent 81.2% of the 2014-2015 ACL. Based on the amount of catch as noted in weekly updates JIMAR staff send to fishery managers and scientists at the PIFSC, it is predicted that the ACL will not be attained before the fishery closes on August 31, 2015. The landings rate during the current fishing year closely followed the trend of the previous year.

If the landings continue at the current rate, the fishery will remain open until August 31, 2015, but will reopen on September 1, 2015, with an ACL that will be determined at the Council meeting in June 2015. This may be the fourth time since the bottomfish fishery has been managed using a catch limit that this limit was not reached before the closing date. In 2011-2012, 65.5% of the ACL was reached. In 2012-2013, 2013-2041, and the current fishing year only 69%, 89.7%, and 81.2%, respectively, of the ACL was reached. The ACL was 346,000 for all four fishing years. For the past two fishing years, despite fewer fishers and fishing trips made, the landings have been significantly higher than in previous years. Some of this is attributed to increases in average individual weight size (pounds per fish). Despite the higher rate of landings this year, the fishery may still be able to stay open, because the ACL is now 27% higher than it was during the 2009-2010 and 2010-2011 fishing years.

Ocean Remote Sensing

P.I.: Mark A. Merrifield [JIMAR Project Lead: Lucas Moxey]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Michael P. Seki, Jeffrey J. Polovina

NOAA Goal(s)

· Healthy Oceans

Purpose of the Project

This project provides satellite remotely-sensed oceanographic data expertise to the NOAA OceanWatch-Central Pacific node (OWCP). This node is a website and database that supplies near-real time, remotely sensed oceanographic and environmental data for the entire Pacific-based communities, including resource managers, researchers, educators, and the general public. The satellite-derived products include ocean surface temperature, ocean color, ocean surface topography, ocean surface wind fields, environmental indicators (Empirical Orthogonal Functions), and high-resolution (1.1 km) thermal infrared High Resolution Picture Transmission (HRPT) imagery from the NOAA Advanced Very High Resolution Radiometer (AVHRR) satellites. The HRPT data is collected daily by the AVHRR receiving station located in Ewa Beach, Oahu (Hawai'i).

Progress during FY 2015

In addition to maintaining all databases and servers and servicing data to OWCP users, this project collaborated with the NOAA Climate Service, Pacific Islands Region, in order to provide customized remote sensing data and quarterly analyses. Additionally, the OWCP data is regularly made available via the NOAA Pacific Climate Information System (PacIS). Direct ongoing contributions towards the NOAA Climate Service, Pacific Islands Region quarterly Climate Impacts and Outlook product can be found at http://www.pacificcis.org/dashboard/pdf/Climate Impacts and Outlook Q1 2015.pdf, and on the PacIS website (http://www.pacificcis.org/dashboard/).

This project also completed the ingestion and data processing of the NASA Aquarius Sea-Surface Salinity v3 products (monthly and weekly) into its satellite data stream. The completed data are now available via the OWCP THREDDS and Live Access Server (LAS) (http://oceanwatch.pifsc.noaa.gov/), which serve as a data portal for the general public and researchers around the world.



Figure 1. Sample of the most recent quarterly report created by the NOAA Climate Service–Pacific Islands Region featuring satellite data created by NOAA OWCP.



Figure 2. Sample Aquarius Sea-Surface Salinity v3 data currently available in the NOAA OWCP THREDDS and LAS portals.

Pacific Islands Territorial Science Initiative

P.I.: Mark A. Merrifield [JIMAR Project Lead: Toby Matthews]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Michael P. Seki, Kimberly Lowe

NOAA Goal(s)

- Healthy Oceans
- Resilient Coastal Communities and Economies

Purpose of the Project

The overarching objective of this JIMAR project is to improve the volume and quality control of catch data from the fisheries of the U.S. Pacific territories of Guam, American Samoa and CNMI. Lack of data collection and quality control in the U.S. Pacific territories has resulted in a paucity of fisheries information to guide management actions mandated by the Magnuson-Stevens Act and other federal law. The small size and modest budgets of territorial governments, relatively low commercial value of the diverse and small-scale fisheries, and limited physical presence of NMFS in these islands have all contributed to inadequate data collection programs. Thus, there is a need to improve the data volume from the territories and for better quality control of those data to conduct accurate stock assessments, especially the monitoring and validation of commercial and recreational landings. The data collected is managed by WPacFIN, which operates a centralized database supporting fisheries monitoring across the Pacific Islands Region. This project will collaborate with several other JIMAR projects and PIFSC programs to promote better communication with management agencies in the territories, establish and improve protocols for fisheries monitoring and sampling, and develop tools for data expansion and summary analyses.



Figure 1. Participants in the Kids Fishing Derby at Naval Base Guam. William Jasper, TSI Project Territorial Fisheries Associate, and DAWR staff assisted with the event to teach kids and their families about fishing in Guam.



Figure 2. The catch of three night spearfishers encountered while on a creel survey in Saipan, CNMI with staff from DFW.

Progress during FY 2015

JIMAR hired a Territorial Fisheries Data Specialist, Toby Matthews, who traveled to each of the U.S. Pacific territories and was introduced to agency staff. Matthews conducted an analysis of creel survey data coverage over the 24-hour day for each fishing method and discussed the results, along with suggestions for improvements, with each territorial agency and as part of the WPacFIN FDCC technical working group. Each territorial agency recognized the value of the improved statistical design and analysis stemming from this position and was supportive of the project's overall objective.

JIMAR also hired a Territorial Fisheries Associate, William Jasper, to reside and work on Guam. Jasper participated in DAWR creel surveys and met with local staff to identify aspects needing improvement. Despite setbacks in developing local engagement by providing similar JIMAR staffing in CNMI and in American Samoa, the TSI project was met with optimism from territorial staff and positive relationships have been formed. These positive interactions will foster future improvements to the creel surveys.

Pacific Tuna Fishery Data Management

P.I.: Mark A. Merrifield [JIMAR Project Lead: Jesse Abdul]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Evan Howell

NOAA Goal(s)

· Healthy Oceans

Purpose of the Project

The objective of this project is to modernize the management of the U.S. tuna fishery purse-seine data to make it readily available for scientific research and fishery monitoring purposes. This project will improve three areas: 1) the accuracy and quality of the U.S. purse-seine catch and effort data collected under the South Pacific Tuna

Treaty (SPTT); 2) the timeliness of data reports to help meet all Regional Fishery Management Organizations (RFMOs) and treaty reporting obligations; and 3) resource managers' access to the SPTT data. This JIMAR project supports these objectives through application development, database development, and data management.

The project objectives will be accomplished by simplifying, improving, and optimizing the Southwest Fisheries Science Center (SWFSC) SPTT data model into an updated PIFSC SPTT data model. The historical SWFSC SPTT data will be migrated and mapped to the new PIFSC SPTT data model to maintain the dataset. The data management responsibilities for the SPTT dataset will be transferred from SWFSC to PIFSC. Reporting modules will be developed to satisfy the RFMOs and treaty reporting requirements. A comprehensive data management system will be developed to allow data entry and data management staff to effectively manage data collected under the SPTT. An automated import process will be developed to import data from each of the various electronic reporting mechanisms to streamline the data import process. The Pacific Islands Regional Office (PIRO) will continue to meet the international treaty mandates for the SPTT fishery using the data managed by PIFSC and the data model developed by JIMAR. The project will also provide technical assistance to the PIFSC Fisheries Research and Monitoring Division (FRMD) by developing data tools and data processes, as well as assisting with data management activities when necessary.

Progress during FY 2015

JIMAR staff developed a simplified data model that captures three of the main data streams collected under the SPTT: the Regional Purse-Seine Logsheet (RPL); Unloading Log (UL); and Final Outturn (FOT). This updated data model was developed in collaboration with PIFSC FRMD, PIRO, and the Office of Science and Technology's (OST) Science Information division (ST6). This updated SPTT data model is easier to understand and retrieve data from than the original SPTT data model.

The SPTT project group utilized the Value Stream Mapping (VSM) process to identify potential systematic improvements to the current data collection, data processing, and data reporting phases in the data life cycle.

The project is working with SWFSC to develop a data migration and verification process to transfer the historical data from SWFSC to PIFSC and populate the new SPTT data model. SWFSC and JIMAR also worked together to refine the Structure Query Language (SQL) data extraction scripts to allow the necessary data to be extracted from the SWFSC SPTT database and migrated to the new PIFSC SPTT data model and verified.

JIMAR project staff began working on the automated electronic reporting import process from a smart Portable Document Format (PDF) used to collect RPL data, eTunaLog, developed by the Secretariat of the Pacific Community (SPC). This process will allow data that is captured in the eTunaLog to be validated and loaded into the PIFSC SPTT data model.

Scientific Advice and Coordination for NOAA Office of Exploration and Research's 2015-2016 "CAPSTONE" Operations in the Pacific

P.I.: Christopher Kelley

NOAA Office (of the primary technical contact): Office of Ocean Exploration and Research

NOAA Sponsor: Jeremy Potter

NOAA Goal(s)

- Healthy Oceans
- NOAA Enterprise-wide Capabilities: Science and Technology Enterprise; Engagement Enterprise; Organization and Administration Enterprise

Purpose of the Project

Science expertise will be acquired through the services of a science advisor supported by the NOAA Office of Ocean Exploration and Research (OER). The advisor will provide advice and expertise during three phases of the Okeanos Explorer Campaign to Address Pacific Monument Science, Technology, and Ocean Needs (EX CAPSTONE) missions. The first phase is project planning whereby the advisor will: 1) work with OER personnel and key NOAA constituents to determine priority geographic areas and science themes for EX operations in



Figure 1. The Okeanos Explorer transiting through the Panama Canal to enter the Pacific where it will conduct the three-year CAPSTONE project. Photo by PI, Christopher Kelley.

out-years; and 2) engage the NOAA and external science and management communities to refine primary science objectives and targets for current year operations. The second phase will be the execution of annual field programs involving multidisciplinary expeditions that integrate science, education, and outreach objectives. The third phase will be the post cruise deliverables that will include high-quality data and information products generated to inform science and management needs soon after cruise completion. The advisor will essentially be the CAPSTONE Senior Scientist serving as a critical OER representative to NOAA and external partners in the U.S. Pacific Islands.

Progress during FY 2015

The project initiated the work under this proposal on February 15, 2015. As detailed in the proposal's "description of work" section, project responsibilities include: 1) out-year planning; 2) expedition planning; 3) expedition execution; and 4) post expedition deliverables. The four EX 2015 expeditions will not begin until July 10 therefore items 3 and 4 do not apply to this reporting period, although planning related to these items has been carried out. With regard to items 1 and 2: the PI has been fulfilling his roles and responsibilities detailed in the proposal for out-year and expedition planning. He developed CAPSTONE science priorities and 2015 cruise plans for EX operations in collaboration with OER staff, external partners, and the science community. These priorities and plans have been presented to OER staff, NOAA and external partners, and interested members of the science community via numerous teleconferences, webinars, and in person presentations. The PI assisted OER staff in the identification of the core and auxiliary science teams and is currently working on 2016 and 2017 plans with OER staff. Ship time requests for 2015-16 were already completed in February and he is currently assisting with the 2017 request.

The project assisted with the permit application and other requirements for entering and working in the Papahānaumokuākea Marine National Monument. A complete sampling protocol was drafted and submitted to
OER for approval and implementation. The project also secured additional funding for sampling supplies through the Smithsonian and NOAA's Deep Sea Coral and Technology Program (DSCTP) and supplies are in the process of being ordered. The project facilitated the establishment of two new Exploration Command Centers (ECCs), one at the University of Hawai'i and the other at the Inouye Regional Center, the former being near completion and almost ready for testing. Regarding travel, at the request of OER administration, the PI flew to Puerto Rico to meet the ship and participate in the transit leg through the Panama Canal in order to become more familiar with ship operations.

Ship-Based GPS Sensing of Precipitable Water

P.I.: Steven Businger

NOAA Office (of the primary technical contact): Joint Polar Satellite Systems

NOAA Sponsor: Mitch Goldberg

NOAA Goal(s)

• Weather-Ready Nation

Purpose of the Project

The project proposes to equip the NOAA ship *Ron Brown* with a geodetic GPS (Global Positioning System) and meteorological sensor package. With this equipment project researchers will be able to observe moisture fluxes streaming across the ship from the sub-tropics to the mid-latitudes while determining the operating and processing strategies that generate the most robust and accurate solutions.

Progress during FY 2015

Project staff successfully installed GPS equipment on the *Ron Brown* during its dock-side stop in Hawai'i. High rate GPS data were collected during the entire CalWater 2015 field campaign, along with meteorological observations. One atmospheric sciences student, Vanessa Almanza, accompanied the ship for one leg of the ship cruise and subsequently participated with the land-based forecast team.

Sustaining Healthy Coastal Ecosystems

P.I.: Mark A. Merrifield [JIMAR Project Lead: Supin Wongbusarakum]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Michael P. Seki, Russell Brainard

NOAA Goal(s)

- · Healthy Oceans
- · Resilient Coastal Communities and Economies

Purpose of the Project

The JIMAR Sustaining Healthy Coastal Ecosystems project mission provides sound science to enable informed and effective implementation of ecosystem-based management and conservation strategies for coral reef ecosystems in the U.S.-affiliated Pacific Islands, the Coral Triangle and Southeast Asian regions. To accomplish this mission, project scientists lead and participate in a multi-partner, integrated, interdisciplinary program of ecosystem assessment and long-term monitoring, benthic habitat mapping, and applied research on the coral reef ecosystems of 40 primary islands and atolls in the Hawaiian Archipelago, the Mariana Archipelago (Guam and the Commonwealth of the Northern Mariana Islands), American Samoa, and the Pacific Remote Island Areas. Using an Ecosystem Approach to Fisheries Management (EAFM), the project also helps develop capacity and provides scientific expertise and technical partnerships to governments and key partners in these regions to inform



Figure 1. Widespread coral bleaching conditions, averaging up to 10% of colonies, were reported during the 2015 American Samoa Reef Assessment and Monitoring Program research cruise around the island of Tutuila.

and support the implementation of effective management of the coral reef ecosystems and sustainable fishery management in the Coral Triangle and Southeast Asia regions. This work supports NOAA and other agencies in meeting the mandates of the Coral Reef Conservation Act of 2000 and various executive orders issued to ensure conservation and protection of the nation's coral reef ecosystems.

Progress during FY 2015

Coral Reef Fish Research. The Coral Reef Fish Research team (led by Dr. Adel Heenan and Dr. Jill Zamzow) met all established objectives for FY 2015, including: 1) conducted baited remote underwater video station surveys on the insular shelf of Guam (depths 0-100m) to assess the status of mesophotic reef fish populations; 2) conducted unbaited and baited remote underwater video station surveys for the NOAA Papahānaumokuākea Marine National Monument Biogeography Project. In addition to providing assessments of reef fish populations, these surveys will be used as part of a methods comparison effort to investigate potential diver-related effects in the survey approach typically used in the NOAA Pacific Reef Assessment and Monitoring Program; 3) produced an annual data report summarizing the reef fish survey data from the Marianas and Pacific Remote Island Areas; 4) conducted reef fish surveys and produced an associated report for the NOAA Habitat Blueprint project in Manell-Gues in Guam; 5) produced a technical report on a benthic cover methods comparison study; 6) produced a report summarizing baseline coral reef fish assemblage surveys conducted in Timor-Leste; 7) completed American Samoa Reef Assessment and Monitoring Program Rapid Ecological Assessment and towed diver fish surveys and produced two associated reef fish monitoring briefs; 8) fulfilled multiple data analysis requests from the Hawai'i Division of Aquatic Resources and other interested parties; and 9) gave research presentations to the American Samoa Department of Marine Wildlife Resources, American Samoa Coral Reef Advisory Group, Hawai'i Institute of Marine Biology, NOAA Scientific Board, NOAA Reef Resilience workshop, and JIMAR external review. Two abstracts from team members were accepted for the 2015 Hawai'i Conservation Conference.



Figure 2. A fish diver, Paula Ayotte, is surrounded by a swarm of fusiliers while conducting a stationary point count (SPC) survey around Palmyra Atoll during the 2015 Reef Assessment and Monitoring Program Cruise to the Phoenix Islands, American Samoa, and the Line Islands.

Benthic Research. In a continuation of the decade-long monitoring of coral reef ecosystem health in the U.S. Pacific Islands, the Benthic Research team (led by Dr. Bernardo Vargas-Angel) was involved in the Pacific RAMP research cruise (February 21-May 3, 2015) in the Pacific Remote Islands Marine National Monument and American Samoa, onboard the NOAA ship *Hi*'*ialakai*. The team conducted surveys of reef systems at around the following islands to document any ecological changes since the prior expeditions in 2012: Johnston, Palmyra, and Rose atolls; Howland, Baker, Jarvis, Swains, Tutuila, Ofu-Olosega, and Ta'u islands; and Kingman Reef.

The Benthic Research team also completed benthic surveys for coral demographics, diversity, colony densities, and coral condition in the Wahikuli drainage (October 30-31, 2014). These surveys were part of a larger project led by JIMAR and CRED scientists in partnership with State of Hawai'i Division of Aquatic Resources (DAR), U.S. Geological Survey, West Maui Reef-2-Ridge Initiative, and U.S. Coral Reef Taskforce Watershed Initiative. The surveys aimed at providing a baseline assessment for coral demographics to evaluate the effectiveness of watershed restorative management practices intended to reduce Land-Based Sources of Pollution threats, namely, siltation and sedimentation stress.

The team held a workshop in Pago Pago, American Samoa (November 18-21, 2014) in response to a specific request from American Samoa's Department of Marine and Wildlife Resources. The workshop provided expertise and support to expand and update the ongoing coral reef monitoring efforts to: 1) potentially incorporate coral demographic metrics (abundance, size-structure, and colony condition) to the current suite of metrics collected as part of the benthic coral reef ecosystem monitoring efforts; and 2) gain a contextual framework that may facilitate data comparability and complementarity between the National and Jurisdictional coral reef monitoring efforts.

The Benthic Research team also achieved all established milestones for FY 2015, including but not limited to: 1) completed analysis of benthic imagery collected at benthic and fish survey REA sites, CAU sites, and climate stations for the 2014 Mariana Archipelago RAMP research cruise; 2) completed analysis of benthic imagery collected at CAU sites and climate stations for 2013 Northwestern Hawaiian Islands RAMP research cruise; 3) completed analysis of benthic imagery from the 2013 Timor-Leste mission; 4) completed lab processing of 270 CAU units from the Northwestern Hawaiian Islands (2013), Mariana Islands and Wake Atoll (2014), and



Figure 3. A gray reef shark (Carcharhinus amblyrhynchos) pictured alongside a school of blackfin barracuda (Sphyraena qenie) on the reefs of Jarvis Island, one of the areas surveyed by the fish team on their most recent monitoring cruise.

Timor-Leste (2013); 5) completed the 2015 American Samoa RAMP research cruise benthic REA demographic summary briefs for adult and juvenile corals; 6) completed and submitted metadata records for the coral demographic surveys off the Mahinahina, Honokowai, and Wahikuli drainages on West Maui; 7) fulfilled over two dozen benthic cover and coral demographics data requests; 8) published a paper on carbonate accretion rates on U.S. Pacific reefs in the open-access journal *PLOS ONE*; 9) generated and updated Standard Operating Procedure manuals for benthic image analysis (stratified random and towed-diver imagery), CAU lab processing, and REA coral demographic surveys; and 10) continued coral demographic and species identification training for the NOAA-PIFSC CRED and partner divers.

Ocean and Climate Change Research. The Ocean and Climate Change (OCC) team (led by Dr. Thomas Oliver) provides high-quality oceanographic data to support scientific research and information relevant to stakeholders, managers, and scientific communities to better understand changes in coral reef ecosystem health associated with climate change, land-based sources of pollution, over-fishing, and other reef ecosystem stressors.

In FY 2015, the OCC team continued with implementation of NOAA's National Coral Reef Monitoring Planclimate (NCRMP-climate) monitoring efforts. This involved a standard suite of oceanographic and ecological information throughout each of NOAA's jurisdictions in the Pacific to assess coral reef ecosystem health and quantify spatial and temporal variability related to a changing climate, including the impacts of global warming and ocean acidification, through the deployment of in-situ instrumentation and collection of discrete water and biological samples. The OCC team's involvement within the NCRMP-climate effort is to investigate nearshore water column thermal structure at four depths down to 25 m (deploying Seabird-56 subsurface temperature recorders [STRs]) in order to: 1) quantify calcification rates of crustose coralline algae (CAUs) and coral communities (Porites spp.-coral cores); 2) assess rates of bioerosion using bioerosion monitoring units (BMUs); 3) evaluate the carbonate system through discrete water sampling and CTD hydrocasts; and 4) investigate cryptic invertebrate biodiversity through the autonomous reef monitoring structures (ARMS) project. These instruments and chemical and biological samples are standardized between the NOAA offices conducting research and monitoring in the Pacific and Atlantic regions, providing results that can be compared between basins.



Figure 4. The Marine Debris Team pose on top of the 52 metric tons of derelict fishing nets they removed from the Papahānaumokuākea Marine National Monument.

During FY 2015, the OCC team implemented the suite of NCRMP-climate monitoring efforts by installing instruments and collecting data during the RAMP cruise through the PRIA and American Samoa, as well as two fly-in missions with the International team to East Timor and the Verde Island Passage in the Philippines. During these efforts, 485 CAUs, 145 STRs, 108 ARMS were recovered and 271 water samples were collected. Further, 485 CAUs, 137 STRs, 96 ARMS, and 70 BMUs were deployed for collection in three years' time.

The team also developed and began a series of deployment for an "Ocean Acidification Diurnal Suite," a set of instruments that allows assessment of temporal variability in the carbonate system in sampled locations. The system was deployed in five locations along the American Samoa RAMP cruise track, and five more in the Verde Island Passage in the Philippines.

Data Management. In FY 2015, the Data Management team (led by Troy Kanemura) continued to support the Division's efforts and activities and focused on addressing several stages in the data life cycle.

To improve planning for data management the team: 1) utilized a resource allocation plan for communication, project planning, and resource prioritization of data management resources; 2) participated on the PIFSC Public Access to Research Results (PARR) implementation team and achieved compliance for the division; 3) worked on the data management project for American Samoa's Department of Marine and Wildlife Resources (DMWR), specifically, building a data model to meet the needs of the American Samoa Coral Reef Monitoring Program (ASCRMP) and the American Samoa Integrated Coral Reef Monitoring Program (ICRMP); 4) provided guidance on industry-standard server, networking hardware, and security software purchases required to fully implement the project's objectives; 5) worked on the data management project for Guam's Long-Term Coral Reef Monitoring Program (LTMP), specifically, the deployment of the benthic image analysis ingestion script to the technical infrastructure available in Guam; and 6) provided personnel to serve as a member on the PIFSC Data Management Steering Committee (DMSC) through January 2015.

To support data collection the team accomplished the following: 1) provided personnel for the HA1501 (ASRAMP) and HA1505 (MHI RFS) cruises to serve as cruise data manager and provided data management support for several field missions; 2) expanded the cruise data manager training program used to broaden the pool



Figure 5. A marine debris SCUBA diver carefully inspects a 10.4 metric ton derelict fishing net entangled in the reef at Pearl and Hermes Atoll.

of cruise data manager candidates and standardize cruise data operations; 3) developed a web-based waypoint ingestion script to populate the Oracle database with site coordinates from a GPS output file; 4) developed a relational data model and web-based data entry interface using Oracle Application Express (APEX) to support CAU lab analysis; 5) provided data management support for the benthic image analysis effort; and 6) provided data management support for two marine debris missions, including but not limited to updates to the APEX data management application.

The Data Management team was also involved in numerous post-collection data processing activities. For all of the aforementioned missions that took place in FY 2015, the data were processed, quality controlled, and migrated to the CRED's enterprise database. For missions funded by Coral Reef Conservation Program (CRCP), the NCRMP data was submitted to the program's data manager.

With regard to data documentation, the Data Management team accomplished the following: 1) generated a complete inventory of CRED data holdings in InPort as the first step towards achieving PARR compliance; 2) developed a workflow to track the metadata and archival activities for each dataset; 3) created complete metadata records in InPort and archived the data with the NOAA National Centers for Environmental Information (NCEI) for two non-NCRMP datasets; 4) provided one metadata coordinator to serve as the point-of-contact for CoRIS and the NMFS InPort Metadata Catalog to support documentation of the Project's datasets; and 5) submitted newly formatted high-quality metadata to CoRIS for four NCRMP datasets (ARMS, Coral Cores, CAUs, and Image Analysis), three Guam Long-term Monitoring Program datasets, and the Marine Debris dataset.

To increase data access and dissemination the team: 1) responded to numerous internal and external requests for data (tracking the end-to-end workflow for those data requests using JIRA tracking software); 2) continued to increase access to the Oracle database within the division using Oracle Structured Query Language (SQL) Developer and Open DataBase Connectivity (ODBC); and 3) provided data management support for the Marianas Trench Marine National Monument GIS Pilot Mapping project, which included conducting several data management consultations with data providers.

On top of all these activities, the team continued to be intensely involved in the consolidation, storage, backup, and security aspects of the division's data holdings and managed to support outreach and educational efforts during the HA1501 American Samoa RAMP cruise and the HA1503 Main Hawaiian Islands Reef Fish Survey cruise.

International Programs. In FY 2015, the International Team (led by Dr. Supin Wongbusarakum) continued work to develop capacity and technically support the implementation of effective management of coral reef ecosystems and sustainable fisheries management among governmental and other key partners in the Coral Triangle and Southeast Asia regions.

Supported by USAID-Regional Development Mission Asia (RDMA), a study entitled "Science and Technology to Promote Sustainable Fisheries in Southeast Asia and the Coral Triangle" was designed and conducted to develop a prioritized list and overview of fisheriesrelated science and technology (S&T) innovations that could potentially assist the Association of Southeast Asian Nations (ASEAN) and Coral Triangle countries in sustainable management of their trans-boundary (i.e., trans-national) fisheries. A survey was used to collect data from 62 experts within NOAA and the U.S. Department of the Interior. Results were published as a technical report and development of a peer-reviewed paper is underway.

In September 2014, members of the International and Ocean and Climate Change teams completed a monthlong field mission (MP-14-19) in Timor-Leste to recover instruments that were deployed in 2012 to monitor ocean acidification and biodiversity. They removed 27 ARMS, 40 CAUs, and 7 STRs, and collected 16 ocean water samples. They also led an informal "Hands-on ARMS" outreach event with more than 100 participants in Dili.



Figure 6. A CRED diver collects a coral core during a Pacific Reef Assessment and Monitoring Program (Pacific RAMP) cruise.

Throughout FY 2015, International team members served as trainers and resource experts for multiple Essential Ecosystem Approach to Fisheries Management (E-EAFM) courses. In Samut Prakarn, Thailand (September 15-29, 2014) team members were resource experts for a course offered by the Southeast Asian Fisheries Development Center (SEAFDEC), "Essential Ecosystem Approach to Fisheries Management (EAFM) and Extension Methodologies." In Dagupan, Philippines (October 19-30, 2014), at the request of the Philippines' Bureau of Fisheries and Aquatic Resources, the team worked with the USAID-supported Ecosystems Improved for Sustainable Fisheries (ECOFISH) Project to conduct two Essential EAFM trainings for approximately 50 participants from regional fisheries offices, provincial governments, state colleges and universities, as well as ECOFISH Project members. In Pedang and Medan, Indonesia (November 10-21, 2014), the International team lead served as resource staff for two Essential EAFM workshops with the support of the Bay of Bengal Large Marine Ecosystem Project (BOBLME) and the Indonesian Ministry of Marine Affairs and Fisheries (KKP).

The International team also led and facilitated several other EAFM-related meetings and workshops in the Coral Triangle and Southeast Asia regions. For the Session on Policy Concept Note on EAFM Implementation at the 47th SEAFDEC Council Meeting in Chiang Rai, Thailand (March 20-April 2, 2015), the team staff developed materials and served as technical resource experts at the meeting. The International team is a member of the International EAFM Consortium (with participants from SEAFDEC, REBYC II CTI (Trawl Bycatch Project), FAO BOBLME, and IMA International) and participated in Phuket, Thailand (April 6-8, 2015) to discuss development of a suite of products on an EAFM for leaders, executives and decision-makers (LEAD). The team served as technical resource participants at the 5th Coral Triangle Initiative (CTI) EAFM Technical Working Group Meeting organized by the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF) with six countries (June 1, 2015) in Manado, Indonesia. It also designed and implemented an EAFM Implementation Workshop to address priority trans-boundary fisheries issues in the Sulu-Sulawesi Seascape in Manado (June 2-5, 2015).

In March 2014, team members delivered spatial data layer products to KKP in Jakarta, Indonesia and provided capacity building seminars on the utility of remotely sensed oceanographic data and climate model projections



Figure 7. OCC Team "Carbonate Diurnal Suite", consisting of SeaFET pH sensor, CTD, ADCP, and array of Programmable Underwater Collectors, deployed on Jarvis Island, PRIAs.

in fisheries management. They further met with KKP's Capture Fisheries and members of the EAFM National Working Group II to discuss how NOAA can further assist KKP in moving toward EAFM implementation and institutionalization.

In May 2015, the International and OCC teams led a month-long field operation to recover and process a suite of biodiversity and ocean acidification monitoring equipment deployed in the Verde Island Passage, Philippines, in partnership with local government agencies, universities, and the Partnerships for International Research and Education (PIRE) Project. This mission brought together partners from the Smithsonian Institution, San Diego State University, Indonesia Biodiversity Research Center, Philippines Department of Environment and Natural Resources-Biodiversity Management Bureau, National Museum, Bureau of Fisheries and Aquatic Resources, University of the Philippines Marine Science Institute, and De LaSalle University. The mission included educational outreach activities for the local community and laboratory-based training for project partners on ARMS.

The International team lead also served as a trainer, facilitator, and working group member in the following workshops: 1) "Socioeconomic Monitoring Training Workshop", held January 19-31, 2015 in Yap, Federated States of Micronesia. The team served in collaboration with the NOAA PIRO office; 2) "Science for Nature and People" working group, held February 9-12, 2015 at NCEAS in Santa Barbara, CA; and 3) "Scorecard Development, Marine Protected Area Management Effectiveness Tool Training, and Second Socioeconomic Measures Workshop", held June 8-12, 2015 in Guam. The team worked with Micronesia Challenge countries including the Republic of Palau, Federated States of Micronesia, Republic of the Marshall Islands, Commonwealth of the Northern Mariana Islands, and Guam.

Ecospatial Information. Led by Dr. John Rooney, the team initiated and/or completed a number of mappingrelated domestic and international projects across the Pacific in FY 2015. Multibeam surveys were conducted around Moorea in French Polynesia during a three-week mission in early FY 2014 to supply data to support the National Science Foundation's Coral Reef Long-term Ecological Research project in Moorea. The Pacific Islands Deep-Sea Coral and Sponge Initiative—a multi-agency three-year project and component of the NOAA Deep-Sea Coral Research and Technology Field Research Science Plan-was awarded funding in FY 2015. As part of the project's first year bathymetric mapping component, existing bathymetry data were provided to the Hi'ialakai to guide new data collection during the 2015 RAMP cruise in American Samoa and the Pacific Remote Islands Marine National Monument (PRIMNM). As part of the USAID-funded partnership with NOAA to provide assistance in satellite mapping of coral reefs and near-shore ecosystems for Timor-Leste, the project continued processing and product development of WorldView-2 satellite imagery for bathymetric mapping and benthic habitat characterization. Also, a NOAA Technical Memorandum (NOAA-TM-NMFS-PIFSC-46) describing the methods for deriving seafloor bathymetry from WorldView-2 satellite imagery was published.

Additionally, several PIFSC and CRCP milestones were completed. Shallow-water bathymetry data was derived from WorldView-2 satellite imagery for Agrihan Island in the Northern Mariana Islands and Baker Island in the PRIMNM. Previously collected multibeam data were processed to fill gaps in existing bathymetry coverage for several areas in Hawai'i, including the grounding site of the *M/V VogeTrader*, along the southern edge of the Kalaeloa/Barber's Point entrance channel, around Oahu, and off the west and northern coasts of Maui. The data, metadata, and associated products for



Figure 8. A CAU two years after deployment.

these completed milestones are available on the project's website at http://www.soest.hawaii.edu/pibhmc/index. htm.

A CRCP funded project was initiated to produce benthic habitat mapping data products (hard and soft seafloor substrate data) to support the Pacific Islands Regional Office (PIRO) with the critical habitat designation for the Pacific coral species listed under the Endangered Species Act.

Two process development and documentation projects were initiated in FY 2015. Another CRCP funded project began a pilot study and methods development to evaluate linkages between benthic habitats and fish populations in Tutuila, American Samoa. Also, as part of the USAID-funded effort in Timor-Leste, draft methods for deriving benthic habitat data using WorldView-2 satellite imagery were developed and documented.

A month long field survey was conducted to collect seafloor imagery for the West Maui and West Hawai'i priority sites to improve understanding of the distribution of coral reef ecosystem benthic communities. This new seafloor imagery, along with imagery previously collected by the project and other agencies for these priority sites, were also classified. The data will be used to develop benthic habitat maps for these areas. A presentation entitled "West Hawai'i Benthic Habitat Mapping" was also delivered at the NOAA IEA Symposium on Kona's (West Hawai'i) Marine Ecosystem: Trends and Status, held September 4-5, 2014, in Kona, HI.

Several data accessibility and management projects were undertaken in FY 2015. A georeferenced map-based data viewer was developed for optical seafloor imagery collected from the Marianas, including Guam and the Northern Mariana Islands (http://www.soest.hawaii.edu/pibhmc/pibhmc_cnmi_guam_optical_data.html#map_data_viewer). The project is also working on two web-based geographic information system (GIS) mapping tool projects. The first, in collaboration with the PIFSC and funded by the Pacific Marine National Monuments, is a pilot project to develop a web-map for the Mariana Trench Marine National Monument (MTMNM), and the second is a Marine Debris Story Map highlighting the 2014 debris mission in the Northwestern Hawaiian Islands.

For the past two years a project based on the Atlantis Ecosystem Model (Atlantis) has been implemented for the coral reef ecosystems of Guam. The Guam model will serve as a decision-support tool to evaluate management strategies, particularly for the testing of management policies and methods for coral reef conservation and

assessment against simulations that represent a real coral reef ecosystem and its complexities. FY 2015 activities to support the ongoing development of Atlantis for Guam included the following.

- A follow up presentation with stakeholders in Guam on the progress of the model development.
- With assistance from Rutgers University, oceanographic ROMS model output from the Coral Triangle was obtained and the necessary parameters were analyzed and included in the Atlantis hydrology module.
- Key coral specific dynamics, their relationships and parameters were obtained and corresponding code was developed and included into the Atlantis ecological module to better simulate coral reef processes.
- The model was applied to investigate the cumulative effects of different disturbances, namely, ocean warming and ocean acidification, addition of nutrients and sediments to coastal areas, and fishing.
- Selected management strategies were simulated and their performance was evaluated based on identified socioecological ecosystem indicators.
- In cooperation with UH NREM and JIMAR human dimension staff, Atlantis was coupled to two human behavior models.

This model development and application work resulted in five manuscripts that have been submitted to peerreviewed journals for publication.

Marine Debris Research and Logistics Support. The Marine Debris and Logistics team (led by Mark Manuel) met all established objectives for FY 2015. The team provided planning, logistical, and operational support for the NWHI Marine Debris Survey and Removal Cruise (SE-14-07), American Samoa RAMP cruise (HA-15-01), Insular MHI Reef Fish Survey Cruise (HA-15-03), Kahekili Ecosystem Recovery Area mission (MP-15-03), Maui and Hawai'i Island Mapping mission (MP-15-05), Philippines Coral Triangle Initiative (MP-15-07), and West Maui Benthic mission (MP-15-12).

From September 25-October 27, 2014, JIMAR's 17-member team of specialists and two NOAA MDP partners successfully completed a 33-day operation aboard the NOAA Ship *Oscar Elton Sette* conducting in-water and shoreline marine debris survey and removal operations at Maro Reef, Lisianski Island, Pearl and Hermes Atoll and Midway Atoll within the Papahānaumokuākea Marine National Monument. The team met this year's primary objective to conduct a large scale survey and remove derelict fishing gear (primarily nets) within historic high density areas. Secondary objectives included continuation of a coral injury assessment study and NOAA MDP standing stock survey and accumulation study at Midway Atoll. In 21-operational days the team surveyed 3.92 km² of shorelines and shallow coral reef environments resulting in the removal of 51,626 metric tons of derelict fishing gear and plastics from the islands and atolls visited.

Other notable MDP Team accomplishments include: 1) identification of four, and removal of two, derelict boats from the lagoon at Pearl and Hermes Atoll that were confirmed to be lost during the 2011 Japan tsunami event; 2) successful disentanglement of three green sea turtles from derelict nets at Pearl and Hermes Atoll; 3) relocation and removal of an extremely large net found in September 2013. The net weighed in at 10.4 metric tons and required more than four operational days of cutting and preparation before being towed back to the ship; and 4) a successful news and media release at the NOAA Inouye Regional Center facility on October 28, 2014 with the support of NOAA MDP partners.

The marine debris staff published a PIFSC internal report entitled, "Marine debris removal and assessment in the Northwestern Hawaiian Islands 2014". This report summarized the team's 2014 ship-based survey and removal effort throughout the Papahānaumokuākea Marine National Monument. Also, a marine debris staff member co-authored a publication (in review) entitled, "Testing marine conservation applications of unmanned aerial systems (UAS) in a remote marine protected area", that was submitted to the *Journal of Unmanned Vehicle Systems*.

Western Pacific Fisheries Information Network (WPacFIN)

P.I.: Mark A. Merrifield [JIMAR Project Lead: Karen Brousseau]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Michael P. Seki, Kimberly Lowe

NOAA Goal(s)

· Healthy Oceans

Purpose of the Project

The objective of this project is to ensure that the best available fisheries monitoring data can be provided by the NOAA Pacific Islands Fisheries Science Center's (PIFSC), Western Pacific Fisheries Information Network (WPacFIN) for research and sustainable management of fisheries in the Pacific Islands Region. This objective is met through computer programming, database and software development, design and management, and other information technology support to fisheries agencies participating in the WPacFIN. JIMAR and PIFSC federal staff work cooperatively with island agencies, contractors, fishermen, and fish dealers to create data systems that implement quality control measures and synthesize fishery-dependent monitoring data for the island areas of Guam, the Commonwealth of the Northern Mariana Islands (CNMI), Hawai'i, and American Samoa. This technical support enables PIFSC and WPacFIN agency partners to produce timely reports and summaries of the best available fisheries data from each island area.

Progress during FY 2015

JIMAR staff worked with the federal contractor, Tukuh Technologies LLC, to develop a new design for the WPacFIN website. With an updated "look and feel", the dynamic website supports user-driven queries and is designed to fulfill many of the frequently-asked nonconfidential data requests, including queries by individual species or group and annual summaries of estimated and reported landings for each island area. It provides better links to publications, metadata, and information from NOAA and partner agencies and provides automated updates to two annual NMFS publications (*Fisheries of the United States* and *Fisheries Statistics of the Western Pacific*) and two annual management-driven reports (Council Management Unit Species and Allowable Catch Limits). The new website will be unveiled in September 2015.

The project began work on the next phase for redevelopment of the WPacFIN website with the following primary objectives: 1) enable user queries to serve available gear-level catch, effort and catch-per-unit-effort (CPUE) data for all island areas; 2) expand annual data queries to provide monthly and quarterly summaries; and 3) enable a few additional species group queries (e.g., based on salinity, habitat, and distances traveled from shore).

JIMAR staff continued converting database applications from the legacy Visual FoxPro (VFP) data processing systems to MySQL and C#. This year the bio-sampling data summary program was completed in C# and the FUS was completely generated in MySQL and C#. Some delays occurred during conversion of all the database applications to MySQL and C#, but this remains a high priority.



Figure 1. JIMAR Staff at the Guam DAWR Resources Kids Fishing Banner.



Figure 2. Guam Marianas International Fishing Derby.

Project staff also completed VFP metadata for Hawai'i and American Samoa for PIFSC's intranet online Fisheries Data Catalog. Guam and CNMI metadata documentation are nearly finished. As the VFP documentation is completed for the VFP metadata Administrative Reports, this information is distributed to PIFSC staff for the online Fisheries Data Catalog.

The project continues to work with the Hawai'i Division of Aquatic Resources (DAR) and the State of Hawai'i's online database contractor, the Hawai'i Information Consortium (HIC), to complete synchronization of DAR data from the HIC (online catch reporting) server with data on DAR's MySQL database server. Project staff continues to work with DAR, HIC, and a PIFSC team on electronic reporting for fishermen.

WPacFIN met all annual reporting deadlines for FY 2014-2015, including those for the *Fisheries of the United States* (FUS, April 15th) and the *Fisheries Statistics of the Western Pacific* (FSWP, August 31st). The FSWP document was completed for calendar year 2012, and the FUS was completed for 2013 and 2014.

Ecosystem-Based Management

Research under this theme focuses on facilitating an ecosystem approach to management in the Pacific Islands region. JIMAR research interests include investigations of the human dimensions of fisheries management, studies of the economic impacts from changes in fisheries, assessments of pelagic and insular fisheries stocks, and extensive public outreach and education efforts.

Economics of Fisheries Initiative

P.I.: Mark A. Merrifield [JIMAR Project Lead: Hing Ling Chan]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Michael P. Seki, Minling Pan

NOAA Goal(s)

· Resilient Coastal Communities and Economies

Purpose of the Project

The purpose of this project is to conduct an economic assessment of commercial and recreational fisheries and of the seafood market in the Pacific Islands Region.

Progress during FY 2015

The project has been successful in continuing data collection and monitoring activities for the Hawai'i longline fishery, American Samoa longline fishery, and the Guam and CNMI small-boat fisheries, and the databases continue to be updated with additional observations. Project activities accomplished during FY 2015 include: 1) co-authorship with the Pacific Islands Fisheries Science Center on an administrative report on the cost-earnings for Hawai'i longline fleet. The report is currently under Scientific Information System (SIS) review; 2) development of a database to present 'Tier 1' economic performance measures for three main fisheries in the Pacific Islands Area. The database is designed in the standardized format consistent with the national reporting system; 3) completed field work for the cost-earnings study for the Hawai'i small boat fishery. More than 800



Figure 1. Swordfish weighed at the Hilo Trollers Tournament on Aug 3, 2014.

responses were collected and data processing was completed; and 4) completed field work for the cost-earnings study for the American Samoa small boat fishery, where more than 50 surveys were collected.

Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific

P.I.: Mark A. Merrifield [JIMAR Project Lead: Dawn Kotowicz]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Michael P. Seki, Justin Hospital

NOAA Goal(s)

· Resilient Coastal Communities and Economies

Purpose of the Project

The need for information on the human dimensions of marine ecosystems is becoming increasingly important in the Pacific Islands region. Uses include but are not limited to: a) assessment of the social, cultural, and economic impacts of fishery management measures on individuals, households, and communities; b) identification of possible management alternatives and accompanying social, cultural, and economic objectives; and c) identification of local perspectives regarding the status of marine ecosystems, and sources of human impacts to such ecosystems over time. JIMAR researchers collect valuable sociocultural information to examine the impacts of these emerging management concerns. Researchers assist the Pacific Islands Fisheries Science Center (PIFSC) in coordinating with local populations and collecting relevant information to describe the sociocultural considerations to managers as they develop management priorities and plans.

Progress during FY 2015

During this year, JIMAR researchers: 1) assessed fishery-marine mammal interactions and described types of interactions in the main Hawaiian Islands; 2) updated social and fisheries data and indicators including



Figure 1. Maui Sporting Goods Storefront. Maui Sporting Goods provided great insight about fishing and fishing communities on Maui to support work on Continued Refinement of Social Indicators of Vulnerability and Resilience in Fishing Communities across the Pacific Islands Region.

expanding them to include the American Samoa, Guam and Commonwealth of the Northern Mariana Islands; and 3) continued to examine issues and effects of the Marianas Trench Marine National Monument (MTMNM) upon fishing and fishermen in the CNMI.

The Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific project is comprised of three sub-projects described below.

Assessment of Fishery-Monk Seal Interactions and Management Perspectives in the Main Hawaiian Islands. This project involved field work to identify and discuss interactions of fishermen with marine mammals. Originally, it was focused on monk seals but the work was expanded to include False Killer Whales and other cetaceans that could be mistaken for False Killer Whales. The purpose of the research is to inform marine mammal researchers and managers at the PIFSC and Pacific Islands Regional Office about fisheries interactions. The project hired a temporary social scientist to lead the field work for this inquiry and worked with her to define the scope of the project, interview protocol, organize results, and present fieldwork results to partners. The initial presentation of the results at the SSC meeting of the WPRFMC was well-received by partners, fishermen, and managers. A draft report of this research has also been written and is currently out for peer review.

Continued Refinement of Social Indicators of Vulnerability and Resilience in Fishing Communities across the Pacific Islands Region. This study continues the development of social and fisheries indices developed by JIMAR researchers for fishing communities at the County Sub-Division level in Hawai'i based on 2010 data. This work is in coordination with social indicators being developed by NMFS social science groups throughout the nation. The purpose of this research is to use secondary data sources to develop a suite of indicators to assess and monitor the social and economic implications of change over time in communities around the region. JIMAR researchers collected updated demographic, social and fisheries data for Hawai'i for additional analysis of the social indicators. These data were shared with partners and will be included in an analysis for fishing communities in all regions of NMFS. Project researchers also collected demographic and social data for the territories in the Pacific Islands Region that help describe social indicators for these geographies. Development of these indicators is ongoing with researchers doing similar work in other territories of the U.S. A NOAA Administrative Report describing the methodology and results of examination of demographic, social, and fisheries data for Hawai'i is currently in review and will be published next year.

Examining Issues and Effects of the MTMNM upon Fishing and Fishermen in Guam and CNMI. In response to partners' needs in Guam and CNMI, the purpose of this sub-project was to further investigate the issues and effects of the MTMNM upon their fishing activities and households. JIMAR researchers continue to examine results of a phone survey of CNMI and Guam residents conducted by sub-contractors to inform MTMNM and local resource



Figure 2. Manele Harbor, Lanai. The harbor staff was very helpful in describing fishing and its participants, and this harbor's role in fishing on Lanai.

managers and scientists. Resource managers are interested in understanding perceptions of residents regarding their participation in the designation process and the effects of its implementation upon fishing households and fishing activities. The phone survey results provide a broad overview of perceptions to be followed by further investigation with selected residents. JIMAR researchers are preparing a printed version of selected results of the phone survey for distribution to the interested public. This will be in a user-friendly format more readily understood by a broader audience than a more technical document.

Pacific Islands Region Observer Program Initiative

P.I.: Mark A. Merrifield [JIMAR Project Lead: John Peschon]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Regional Office

NOAA Sponsor: Michael Tosatto, John Kelly

NOAA Goal(s)

Healthy Oceans

Purpose of the Project

The Pacific Islands Regional Observer Program (PIROP) is required by a fishery management plan (FMP) developed by the Western Pacific Regional Fishery Management Council (WPRFMC). This FMP was approved by the National Marine Fisheries Service (NMFS) with the authority of the Magnuson-Stevens Fishery Conservation and Management Act, the Endangered Species Act, and the Marine Mammal Protection Act. The observer program provides high quality data on protected species interactions (sea turtles, marine mammals, and seabirds), catch composition, fishing effort, and selected fisheries research projects from commercial longline vessels based in Hawai'i and American Samoa. The data are collected at sea by fisheries observers, and it is the responsibility of the JIMAR PIROP debriefers to train and debrief those observers. The focus is on maintaining the overall quality and integrity of the fisheries-dependent data. Debriefers also perform other duties, as needed,



Figure 1. John Peschon conducting in water, safety skills training in Pearl Harbor.



Figure 2. Josh Lee conducting fire suppression safety training at the IRC boat yard.

including editing data, assisting with daily operational needs, developing program protocols and procedures, filling enforcement-related documents, editing management-related documents, and other tasks.

Progress during FY 2015

Over the reporting period, JIMAR program staff debriefed 116 of 397 total observed trips and finished data editing process steps on 152 of 451 total trips. Program staff led instruction sessions and developed a training module for an observer training class and two safety refresher training classes. Project staff maintained all current certifications, including AMSEA. An Institutional Animal Care and Use Committee (IACUC) protocol, which enables the handling of live animals as a part of emergency at-sea readiness, was renewed. The program staff compiled and presented seabird banding and interaction data at the annual PSG, WPRFMC Scientific Advisory Committee, ACAP, and NPAWG meetings. Program staff continued to work with stakeholders on the development and implementation of an electronic reporting system.

Pacific Islands Region Outreach and Education Program

P.I.: Mark A. Merrifield [JIMAR Project Lead: Gary Karr]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Regional Office

NOAA Sponsor: Michael Tosatto, Wende Goo

NOAA Goal(s)

- · Healthy Oceans
- Resilient Coastal Communities and Economies

Purpose of the Project

The objectives of this project are to plan, develop, and implement effective communications, outreach and education programs as a partnership between JIMAR and the NOAA Fisheries Pacific Islands Region (PIR)–including both the Pacific Islands Regional Office (PIRO) and the Pacific Islands Fisheries Science Center (PIFSC). To carry out the project, the JIMAR employees make up a Communications Team that serves as a resource, advisor, and point of contact for outreach and education activities for JIMAR and NOAA Fisheries PIR staff of both offices. This project directly supports the JIMAR theme of achieving a sustainable balance between the forces of coastal development, conservation, and preservation goals by performing outreach and educational activities.

Progress during FY 2015

During FY 2015, the program produced communications, outreach, and education materials that JIMAR and/or NOAA Fisheries PIR staff displayed or distributed directly to the public, partners or stakeholders at community events and other venues. The program supports all the divisions and programs within both PIRO and PIFSC creating a consistent outward facing message and image. Participation in outreach and education events informed and engaged the public and stakeholders concerning PIRO and PIFSC efforts to manage, conserve, and recover the marine resources under its jurisdiction. The materials provide information to the public, partners, collaborators, and stakeholders that communicate NOAA's mission to the public and other audiences in easy to understand language and a visually appealing format.

In FY 2015, the program designed and launched social media accounts for the PIRO. In the six months since going live, the Facebook and Twitter accounts have garnered 622 and 117 followers, respectively. These channels provide another way to get information to partner agencies, stakeholders, and the public in real time.

NOAA Fisheries Science Camp. The most significant educational activity carried out during 2015 was the second annual NOAA Fisheries Science Camp held at the NOAA Inouye Regional Center (IRC), June 8-10 and 12, 2015. The camp theme was "Using Technology to Study Ocean Life and Ecosystems" and included a marine science career component. The target audience was eighth graders from public and charter schools, with an emphasis on reaching under-represented students. The four-day camp for 45 students consisted of nine science



Figure 1. NOAA Fisheries Pacific Islands Region outreach and education tables at Habitat In Your Neighborhood at Kapolei Commons on November 29, 2014, focused on healthy reefs and habitat conservation. The one-day event attracted an estimated 3,000 attendees who learned about marine habitat, NOAA Fisheries, and its mission.

modules conducted over three days and culminated with a team challenge, evaluation and award ceremony on the fourth day. The team challenge required the campers to utilize what they learned while rotating through the science modules to develop a research plan.

The nine science modules included the following.

- Marine Debris Removal Project. Hands-on activity with GPS and computers that informs campers about marine debris and how it relates to Hawai'i.
- Fishery-Independent Sampling Techniques and Stock Assessment. Students learn various fishery independent sampling techniques and basic population modeling principles.
- *Fish Life History and Dissection*. Hands-on lab experience that introduces campers to procedures and tools that fisheries biologists use to process specimens for measurement data and sample extraction for analysis.
- *Marine Food Webs*. Introduces campers to marine food webs and basic ecological concepts that structure energy flow and animal interactions.
- Amazing World of Marine Plankton. Educates students on marine plankton including collection methods, types, importance, and environmental threats.
- *Hawaiian Monk Seal Crittercam: A Seal-Eyed View*. Campers learn about and test hypotheses using different techniques and technologies to understand the diet and feeding behavior of Hawaiian monk seals.
- *Fishing Gear and Casting Lesson*. Hands-on activity where campers learn and practice casting a rod and reel; go "fishing;" log catch data; and learn about the importance of fishing and fisheries-dependent data.
- Observer and Sustainable Fisheries Programs-Conservation and Management. Students perform basic data analysis using observers' logbook data on seabird interactions; learn to identify several turtle species and the mitigation techniques used to reduce seabird and turtle interactions with fishing gear.
- Sea Safety. Hands-on activities that teach campers the importance of safety and preparedness while at sea including extinguishing a fire, man overboard drills, and communications while at sea.

Undergraduate students from the UH College of Education and Chaminade University along with a marine science teacher were recruited to serve as team leaders. A training day was held for the team leaders the week before camp to familiarize them with the science modules, activities, and camp schedule. The expansion to four

days as opposed to last year's two-day camps was a result of internal evaluations.

All camp costs were covered by a grant from NOAA Fisheries to JIMAR, including items such as lab equipment, supplies, and printing costs. Camper applications were organized and processed through a dedicated online registration website and e-mail account.

The science camp was managed and staffed by NOAA Fisheries and JIMAR PIRO communications team employees. Over 35 NOAA Fisheries and JIMAR scientists and staff from PIRO and PIFSC worked together to conduct activities in the IRC building and labs, providing the students with unique hands-on experiences. They also exposed campers to the diversity of backgrounds and career fields represented at NOAA Fisheries.



Figure 2. 2015 NOAA Fisheries Science Camp participants get hands-on lessons and lab experience processing fish specimens during the Life History and Dissection module. PIFSC's Ryan Nichols provides students with a basic understanding of external and internal anatomy of bony fishes.

To celebrate the campers' accomplishments, a short certificate ceremony was held during which students were given their certificate of camp completion and a NOAA bag with educational items. A commemorative group photo of campers, team leaders, instructors, and staff was mailed to each student. In addition, groups were recognized that excelled at the Challenge Event in two categories: Best Overall Presentation and Most Creative Design for their clay model.

From the campers' post evaluations and a review of the notebooks, it was evident that they enjoyed the camp and absorbed most of the information presented, especially from the fish dissection and marine plankton modules.

Outreach Events. The events in which the program participated ranged from an elementary class size to over 5,000 at the Hawai'i Ocean Expo. JIMAR communications team staff coordinated and implemented participation as well as designed and produced displays and informational materials for outreach events and activities throughout the year.

During FY 2015, the program developed, scheduled and conducted Habitat In Your Neighborhood (HIYN) outreach events at local shopping malls. The first was held at Windward Mall on November 1, 2014, followed by Kapolei Commons during their Snow Day event on November 29, 2014, and then Kahala Mall on January 31, 2015. The activities and displays were designed to engage the public and raise their understanding of the importance of a healthy marine habitat for fish and other living marine animals. Each HIYN event included activities and displays for all ages. Elements of this outreach were incorporated into displays at other events such as the Hawai'i Ocean Expo at the Neal S. Blaisdell Center Exhibition Hall. Other events staffed or supported during FY 2015 include the following.

- Hawai'i Conservation Conference
- Windward Mall Ocean Expo
- · Habitat In Your Neighborhood at Windward Mall, Kapolei Commons, and Kahala Mall
- · Career fairs for various middle schools
- · Welcome Back Whales event at Turtle Bay Resort
- · Hawai'i Fish and Dive Expo
- Science Alive! at Bishop Museum
- Hawai'i Ocean Expo
- Earth Day events around Oahu and one in Hilo



Figure 3: In the Amazing World of Marine Plankton module, 2015 NOAA Fisheries Science Camp participants learn how to identify marine species using dissecting and compound microscopes in conjunction with a plankton key.

• North Shore Ocean Fest at Turtle Bay Resort-A World Ocean's Day Celebration

Outreach and educational printed materials and displays produced by project staff during FY 2015 include the following.

- Careers in Marine Science (college) brochure
- Careers in Marine Science (middle school) brochure
- PIFSC in American Samoa pamphlet
- One NOAA in the Pacific Islands Region brochure
- One NOAA in American Samoa brochure
- Let Sleeping Seals Lie posters (revision)
- Fishing Around Monk Seals flyer
- Hawaiian Monk Seal Sightings magnets
- · Protect Hawaiian Monk Seals outreach cards
- Turtle Stranding magnets (revisions)
- Marianas Trench Marine National Monument Planning Update pamphlet
- Marine National Monument brochures
- Federal Programs 2014 Annual Report
- Purse Seine Discard Logbooks and Forms (reprint)
- PIFSC Quarterly Report Bulletins design and layout
- PIFSC Western Pacific Regional Fishery Management Council report covers
- Layout, design, branding and printing materials for green sea turtle public hearings in Hawai'i, American Samoa, Guam and CNMI
- · Layout, design, and branding for revised Hawaiian monk seal critical habitat final rule materials
- Hawai'i Retail Seafood Markets: Observations from Honolulu (2007-2011)
- Banners, posters and displays for Hawai'i Fish and Dive Expo, Science Alive! at Bishop Museum, Hawai'i Ocean Expo and North Shore Ocean Fest events
- Wheel of Fortune-habitat educational activity materials
- · Graphics, text revision, design and layout for Hawaiian monk seal prey consumption infographic
- Graphics, text revision, design, and layout for Hawaiian monk seal and Toxoplasma gondii life cycle
- Twitter account development
- Facebook account development
- PIRO website revisions, e.g., Federal Register Notices, proposed and final rules, page content edits and updates, new pages, etc.

- · PowerPoint presentations for career days
- · Various videos and video clips for presentations and media availability events
- Final revised NOAA Fisheries Interactive Touch Screen Kiosk Project content development and final sites determination–Kapolei Library and SOEST POST building.

Pacific Islands Region Sustainable Fisheries Initiative

P.I.: Mark A. Merrifield [JIMAR Project Lead: Melanie Jordan]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Regional Office

NOAA Sponsor: Michael Tosatto, Robert Harman

NOAA Goal(s)

- · Healthy Oceans
- Resilient Coastal Communities and Economies

Purpose of the Project

The project has two components: 1) to collect, compile, and analyze social science data supporting regional federal fisheries policy-making per the Fishery Conservation and Management Act (FCMA), the National Environmental Policy Act (NEPA), and other federal statutes (social science); and 2) to further communication with stakeholders in the region—including fishermen, the general public, non-government organizations, and government agencies via outreach. In addition, JIMAR staff assists the PIRO Sustainable Fisheries Division (SFD) staff with various NOAA fisheries initiatives in the Region, as appropriate.

Progress during FY 2015

During the project year, the JIMAR project staff collaborated with the JIMAR Communications Team on various projects of interest to the SFI effort. This included: 1) designing a variety of graphic materials such as fact sheets, posters, announcements, flyers, etc. to educate the public on PIRO and its various programs; 2) preparing materials for outreach events including the NOAA Fisheries Science Camp; and 3) assisting various PIRO staff in developing presentations for national conventions and gatherings that have agency-wide bearing. The project staff also produced informative advertising materials for publications that serve the fishing community, such as *Hawai'i Fishing News* and *Lawaia*.

Stock Assessment Research Program

P.I.: Mark A. Merrifield [JIMAR Project Lead: Marc Nadon]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Michael P. Seki, Beth Lumsden

NOAA Goal(s)

· Healthy Oceans

Purpose of the Project

The goals of this JIMAR program are to: 1) assess the status of pelagic species in the Pacific Ocean; 2) assess the status of insular resources in the Pacific Islands Region (PIR), including the Hawaiian Archipelago and U.S. Territories; and 3) assess the impacts of fishing on these various stocks.

PIFSC and JIMAR staff primarily conduct collaborative assessments of pelagic fish stocks in the Pacific Ocean together with scientists from Japan, Taiwan, Canada, Korea, China, Mexico, the Inter-American Tropical Tuna Commission (IATTC), and the Secretariat of the Pacific Community (SPC). The assessments are conducted under



Figure 1. JIMAR diver conducting a survey of coral reef fishes around Maui, June 2015.



Figure 2. Bayesian surplus production model results for the Pacific blue marlin stock using various model types. Top panel shows relative biomass (biomass divided by biomass at maximum sustainable yield) and bottom panel shows relative harvest rate (harvest rate divided by harvest rate at maximum sustainable yield). From Chang et al. (2015).

the auspices of the International Scientific Committee for Tuna and Tuna-like species in the North Pacific Ocean (ISC). Priority is given to marlins, swordfish, and oceanic sharks species (blue, oceanic whitetip, silky, mako, and thresher sharks) in the North Pacific Ocean. Researchers on this project also investigate bottomfish, coral reef fishes, and crustaceans in the PIR. The primary objective of these investigations is to provide quantitative information that meets defined standards of scientific rigor and satisfies management requirements for sustainable exploitation of these resources.

Progress during FY 2015

To support insular assessments, work on a bottomfish cooperative fishery research program (jointly engaged by PIFSC, JIMAR, and the fishing industry) continued in waters surrounding the MHI, Guam, and American Samoa. The goals of this research are to: 1) assess the feasibility of conducting cooperative bottomfish fishery-independent surveys in the PIR using local commercial fishermen; 2) expand fishery-dependent sampling of bottomfish at major landing ports and/or auctions throughout the PIR; and 3) collaborate with local bottomfish fishermen to better understand technological and operational changes within the fishery and its impact on catch per unit effort (CPUE). Gear calibration cruises were conducted to compute provisional calibration metrics between abundance indices generated from commercial fishing data, active acoustics, and stationary camera devices. Fishery-independent diver surveys of reef fish populations were also conducted during research cruises in Hawai'i and American Samoa. Furthermore, assessment work for U.S. territories (Guam, America Samoa, and CNMI) bottomfish stocks using a Bayesian production modeling platform was completed. A paper on the assessment of coral reef fish stocks around the Hawaiian Islands has been completed and is undergoing final editing before being published in *PLoS ONE* with a JIMAR project staff as lead author. A paper on the automated standardization of fish data collected using different survey approaches was completed as well, but publication is currently on hold pending the publication of an accompanying paper by collaborators at the University of Miami.

To advance the development of stock assessment methods and completion of stock assessments for pelagic species in the Pacific Ocean, JIMAR staff participated in a suite of international scientific workshops and symposia. Of significance were the workshops of the ISC Shark Working Group and ISC Billfish Working Group and presentations at the Center for the Advancement of Population Assessment Methodology (CAPAM) workshop. The outcome from these workshops and the associated work included: 1) data preparation and stock assessment of shortfin mako shark, which included data from the North Pacific and Hawai'i; 2) completion of a stock assessment for North Pacific striped marlin; and 3) completion of standardized catch rates for North Pacific blue shark and billfish species. JIMAR staff led most of these efforts (see publication list) and collaborated closely with federal staff on the rest of them.

Sixteen publications were completed by JIMAR staff in the FY 2015 performance period. Six of these publications are articles in refereed scientific journals covering biological research for billfish and shark catch rate, reef fish work, and advanced stock assessment methods. Other publications include five ISC Billfish Working Group working papers and three ISC Shark Working Group reports.

Western Pacific Fisheries Economic Integration

P.I.: Mark A. Merrifield [JIMAR Project Lead: Kolter Kalberg]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Michael P. Seki, Justin Hospital

NOAA Goal(s)

Resilient Coastal Communities and Economies

Purpose of the Project

This JIMAR project focuses on processing and analyzing pertinent socioeconomic data to enable efficient and replicable analyses of area-based fishery management measures affecting fishing fleets active in the Western, Central, and Eastern Pacific Ocean.

Progress during FY 2015

JIMAR project staff compiled the economic data and assisted with development of spatial analysis using the FishSET modified framework. Project staff supported development of a report used by the PIFSC director to support the policy and management decision-making processes regarding the Hawai'i longline fishing in the Pacific Remote Island Areas (PRIAs). Products included aggregated economic information, heat-signature maps, and other spatiotemporal figures. All products and deliverables adhered closely to NOAA confidentiality policies while confidential reports were provided to permitted individuals. A few summary products have been made available on PIFSC blog, however, the development of products for participants in the Hawai'i-based longline fleet as well as other stakeholders and government agency representatives is ongoing.



Figure 1. Action at pier 38 where a Hawai'i-based longline vessel is gearing up for a trip.



Figure 2. Captain David Lewis, a Hawai'i-based longline vessel owner/operator and JIMAR researcher Dr. Michele Barnes-Mauthe conversing at pier 38.

Protection and Restoration of Resources

This theme seeks to develop tools and approaches for protection and restoration of living marine resources, habitats, and ecosystems in the Pacific Islands region. JIMAR scientists work to protect, restore, and educate the public on endangered species of marine turtles, Hawaiian monk seals, and cetaceans. JIMAR works to protect and restore pelagic and insular fisheries through stock assessments, fisheries monitoring, and fisheries information exchange. JIMAR also conducts research and mitigation efforts on marine debris around the Pacific Islands.

Cetacean Research Program

P.I.: Mark A. Merrifield [JIMAR Project Lead: Marie Hill]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Michael P. Seki, Erin Oleson

NOAA Goal(s)

· Healthy Oceans

Purpose of the Project

The JIMAR Cetacean Research Program (CRP) is charged with assessing the status of cetacean stocks within the U.S. Exclusive Economic Zone (EEZ) waters of the Pacific Islands Region (PIR), which encompasses the EEZ around the entire Hawaiian Archipelago, Johnston Atoll, Kingman Reef and Palmyra Atoll, Baker and Howland Islands, Jarvis Island, American Samoa, Wake Island, Guam, and the Commonwealth of the Northern Mariana Islands (CNMI). At least thirty-four cetacean stocks occur in the Hawaiian EEZ alone, and many more exist in the other PIR EEZs, though most are largely unstudied. Assessment of cetacean stocks includes conducting inventories of species within each PIR EEZ, followed by evaluation of the structure of the stocks within each EEZ, the population status of each stock, and evaluation and mitigation of human impacts on cetacean stocks.

Progress during FY 2015

During August-September 2014 the CRP conducted surveys off Moloka'i in the main Hawaiian Islands. The primary goals of this effort were to collect photographs and biopsy samples, and deploy satellite tags on a variety of cetacean species to assess windward versus leeward movements and population structure. The project surveyed 1,092 km of trackline. Sighting rates were low because conditions were rough, which reduced the visibility significantly. There was a single encounter with Blainville's beaked whales (*Mesoplodon densirostris*), one encounter with short-finned pilot whales (*Globicephala macrorhynchus*), two encounters with unidentified beaked whales (one was a probable Blainville's), and two encounters with unidentified odontocetes. Project staff collected over 1,000 photos. A High-frequency Acoustic Recording Package (HARP) was also deployed to record vocalizing cetaceans in the area during the survey.

During February-March 2015, the CRP conducted small boat surveys off Saipan in the CNMI to look for humpback whales (*Megaptera novaeangliae*). It's known that they occur there during winter/spring months (December-April) based on accounts by local fisherman and dive operators, a sighting at Marpi Reef during a 2007 shipboard survey of the Guam/CNMI EEZ, and recordings from the project's passive acoustic devices on the seafloor off Saipan and Tinian. During eight survey days on the water, the project encountered four mom/ calf pairs and another four individuals that were identified with photographs. JIMAR staff collected four biopsy samples, three of which were from mothers. The presence of mothers with small calves suggests that the waters off western Saipan and likely adjacent areas may be a breeding area for humpback whales. The wintertime conditions of high winds and seas limited the survey area to the west side of Saipan. All but two of the sightings were over Chalan Kanoa (CK) Reef.

The CRP conducted a 30-day ship survey in the waters surrounding the Mariana Archipelago during May-June 2015. The primary goal of the survey was to understand cetacean distribution throughout the archipelago by collecting tissue samples and photos for assessment of population structure and by deploying satellite tags on



Figure 1. Humpback whale mother and calf photographed off Saipan in March 2015.



Figure 2. False killer whale tagged off Asuncion, CNMI during the May-June ship survey aboard the NOAA R/V Oscar Elton Sette.

certain species to study their movements and habitat use. During the survey JIMAR staff encountered forty-two groups of cetaceans. Nine species were identified; two of which were encountered for the first time since the project began working in the Marianas in 2010. One of the new species was the Bryde's whale (*Balaenoptera edeni*), and the other was Risso's dolphin (*Grampus griseus*). The project collected over 6,600 photos, obtained fifty-two biopsy samples from six species, and deployed a satellite tag on a false killer whale (*Pseudorca crassidens*) off Asuncion. In addition, the project recycled two HARPs off Saipan and Tinian and deployed a new HARP off of Pagan to listen for migratory baleen whales.

The CRP's acoustic monitoring of the Hawai'i-based tuna-target longline fishery using small, autonomous HARPs is ongoing and a new phase of deployments was initiated this year. This phase involves single instrument deployments on vessels across the fleet on a voluntary basis. Preliminary meetings with captains, owners, and crew members identified vessels that are willing to participate in the research. Once a particular vessel has agreed and is assigned an observer, a HARP is placed onboard to acoustically monitor approximately half of the fishing sets for a given trip. The acoustic data collected is analyzed for false killer whale vocalizations in relation to fishing activities and evidence of catch or bait depredation. A Vietnamese translator was hired to help facilitate pre- and post-trip meetings with the Vietnamese-American sector of the fleet that consists of over half of all Hawai'i-based longline vessels. To date, over fifty different longline vessels have agreed to participate in this research and fourteen vessels have completed a voluntary deployment of a longline HARP. In addition to this ongoing research, the results from previous research involving multiple chartered fishing trips on a single vessel are being written up into a scientific publication that is scheduled for submission by the end of 2015.

Hawaiian Monk Seal Northwestern Hawaiian Islands Research Seasonal Support

P.I.: Mark A. Merrifield [JIMAR Project Lead: Lizabeth Kashinsky]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Michael P. Seki, Charles Littnan

NOAA Goal(s)

Healthy Oceans

Purpose of the Project

The JIMAR Hawaiian Monk Seal Research Program (HMSRP), in collaboration with the NOAA PIFSC Protected Species Division, conducts studies on the Hawaiian monk seal (*Monachus schauinslandi*), the most endangered marine mammal occurring entirely within U.S. jurisdiction. The Northwestern Hawaiian Islands Research Seasonal Support project implements population assessment, health and disease, survival enhancement, foraging, and behavioral research as well as standard enhancement activities on Hawaiian monk seals primarily in the Northwestern Hawaiian Islands (NWHI) to augment year-round program activities in the main Hawaiian Islands (MHI). Field staff and volunteers are deployed on a seasonal basis to collect data and conduct recovery activities at up to six main breeding sites and opportunistically at Necker, Nihoa, and Ni`ihau. Field research activities include visual and photographic monitoring, tagging, pelage bleach marking, health screening, foraging studies, de-worming research, translocation, and other recovery actions. These actions may include hazing or removal of aggressive males, mitigation and deterrence of shark predation, necropsies, specimen collection, behavioral modification, vaccination research, disentangling, abscess treatment, marine debris removal, vaccination, and supplemental feeding of post-release rehabilitated seals.

Progress during FY 2015

During the 2014 field season (June 16-September 19, 2014), nine JIMAR staff and five volunteers were deployed and established field research camps at French Frigate Shoals (FFS), Laysan, Lisianski, Pearl and Hermes Reef, and Kure Atoll. In addition, nine field staff and five volunteers were hired to establish field research camps at FFS, Laysan, Lisianski, Pearl and Hermes Reef, and Kure Atoll for the 2015 field season. Training for 2015 JIMAR field staff began April 22 and included boat training, data collection techniques, Wilderness First Aid, animal handling and abscess treatment, and specimen collection and necropsy techniques. Field personnel participated in securing and packing food stores and quarantine clothing, testing boats, communication systems, and other equipment, and loaded all supplies and equipment on the NOAA ship *Hi'ialakai*. All field staff and volunteers departed on May 18, 2015. Activities undertaken by the JIMAR HMSRP during the reporting period, which encompasses the majority of the 2014 field season and beginning of 2015 field season, involved: 1) collecting survey and life history data and specimens; 2) tagging and marking seals for long-term identification; 3) documenting and mitigating mortality caused by males exhibiting aggressive behaviors towards other seals; 4) shark predation monitoring and mitigation to prevent monk seal pup mortality; and 5) fishing for predatory



Figure 1. Monk Seal Field Camp set-up. Photo by Kahi Pacarro, photo taken under Marine Mammal Permit #16163-01.



Figure 2. Paired Hawaiian Monk Seals. Photo by Koa Matsuoka, photo taken under Marine Mammal Permit #16163-01.

Galapagos sharks in nearshore areas of pupping sites at FFS. Field staff also participated in translocation activities and interventions including disentanglements and marine debris/plastics/trash removal to mitigate threats to the HMS and other wildlife, and a few miscellaneous actions (human assisted pup exchanges and umbilical cord snippings). Translocation activities included translocations between breeding sites to enhance survival and within FFS to mitigate shark predation.

Hawaiian Monk Seal Research Program

P.I.: Mark A. Merrifield [JIMAR Project Lead: Lizabeth Kashinsky]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Michael P. Seki, Charles Littnan

NOAA Goal(s)

· Healthy Oceans

Purpose of the Project

The JIMAR Hawaiian Monk Seal Research Program (HMSRP) conducts research on the Hawaiian monk seal (HMS), the most endangered marine mammal occurring entirely within U.S. jurisdiction. There are approximately 1,100-1,200 individuals and the population is declining. The program conducts studies designed to promote sound conservation and management of the species by characterizing natural and anthropogenic factors that may impede population recovery. Research focuses on connections between population biology, foraging ecology, individual health, and environmental and oceanographic parameters in the North Pacific. The program develops, tests, and implements tools to assist in recovering the species.

Progress during FY 2015

Accomplishments during the report period included population monitoring and assessment, survival enhancement. foraging ecology characterization, health and disease evaluation, and behavioral research. JIMAR staff played a crucial role in the establishment of seasonal field camps in the Northwestern Hawaiian Islands for the 2014 and 2015 field seasons. JIMAR staff reviewed and revised protocols, trained field personnel in data and specimen collection techniques, participated in research cruises, and provided logistical support to remotely deployed field staff. JIMAR staff served as Chief Scientist on the research cruises, were deployed at a field camp at FFS for the duration of the 2015 field season, and at Nihoa Island on two short field missions in September 2014 and June 2015 to conduct research and retrieve data from a



Figure 1. Release of monk seal back into wild. Photo by Brenda Becker, photo taken under Marine Mammal Permit #932-1905-00.

remote camera system designed to collect seal images on a year round basis. Project staff collected survey and life history data and specimens in the main Hawaiian Islands (MHI), including during the program's second collaborative monk seal survey of Ni`ihau, yielding the highest single day count for an individual island in the MHI. JIMAR personnel responded to and coordinated monk seal stranding responses in the MHI. Project staff also played a key role in the coordination of an emergency evacuation of JIMAR field staff at three of five field camps deployed in the NWHI during the 2014 field season due to hurricane threats. During the 2014 and beginning of the 2015 field seasons, JIMAR staff directly translocated a total of 11 weaned pups from subpopulations with lower survival to sites with higher survival. Six seals (four pups and two juveniles) in poor body condition were brought to The Marine Mammal Center (TMMC) captive care facility in Kona for rehabilitation. Four of these

patients were released in the NWHI during September 2014 and the two remaining patients were released in the NWHI during March 2015. Two additional pups were collected during the 2015 deployment cruise in May for rehabilitation at TMMC facility where they are currently being cared for until they are deemed ready for release into the wild.

In April 2015, JIMAR staff participated in a scientific exchange with international Mediterranean monk seal researchers. This allowed JIMAR staff opportunities to take leadership roles fulfilling international conservation needs and mandates of the International Union for Conservation of Nature (IUCN Seal Specialist Group) and other groups, cultivate international research, and promote scientific education and training. Additional accomplishments by the program include: the development of a data interface that allows for greater efficiency and improved ability to analyze data; participation in directed studies of MHI seal behavioral observations for anthropogenic interactions; and



Figure 2. HMSRP staff applying a National Geographic Crittercam (videocamera) to a monk seal on Oahu. Photo by Barbara Billand, photo taken under Marine Mammal Permit #16163-01.

participation in ongoing response events in the MHI. Responses included the capture and hook removal for seals on Kauai, Oahu, and Maui. JIMAR staff also played a major role in a diesel spill response off Barbers Point in January 2015. During this response event JIMAR staff assisted with the capture, transport, and care of four adult seals in a single day. Staff also participated in necropsies and rehabilitation efforts, including the capture, veterinary care, and husbandry of debilitated seals. The foraging ecology program continued analysis of MHI seal scat for dietary studies and deployed telemetry equipment, including seal-mounted cameras (aka Crittercams) to record high-definition video of HMS foraging behavior. Health and disease research included collection of biomedical samples for disease surveys in the MHI in conjunction with telemetry deployments and from stranded animals and sample analysis at various laboratories. JIMAR personnel continued collaboration with outside researchers to assess risks posed by *Toxoplasma gondii* to monk seals. The program also continued an ongoing reorganization project to improve management of specimens and conducted ongoing maintenance of a live animal care life support system.

Marine Turtle Research Program (MTRP)

P.I.: Mark A. Merrifield [JIMAR Project Lead: Devon Francke]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Michael P. Seki, Frank Parrish

NOAA Goal(s)

· Healthy Oceans

Purpose of the Project

The Turtle Research Program or TRP (formerly known as the Marine Turtle Research Program) project includes nine discrete elements: 1) research to reduce or mitigate high-seas and coastal fishery by-catch of sea turtles; 2) research on the general biology, life history and ecology of sea turtles in coastal marine habitats and on nesting beaches; 3) monitoring of sea turtle population trends for stock assessments; 4) simulation modeling of long term sea turtle datasets to better understand population dynamics; 5) assist with health assessments and disease investigations with focus on sea turtle fibropapilloma tumor disease; 6) administration of a sea turtle stranding and salvage network for research and live turtle rehabilitation; 7) educational outreach to the public focused on sea turtle research results; 8) maintenance of efficient and secure

computerized storage, management, and retrieval of sea turtle research data; and 9) training of observers training in the collection of sea turtle data aboard commercial longline fishing vessels.

Progress during FY 2015

JIMAR TRP researchers successfully completed many research activities during the reporting period and continued to make significant scientific contributions towards TRP goals and objectives. JIMAR TRP staff accomplishments are as follows.

- Managed a Pacific-wide satellite-tracking database, prepared maps, analyzed satellite-tracking data, and provided data for publication in peer-reviewed journals. Data was managed and maps were produced for 20 turtles from five projects throughout the Pacific during FY 2015.
- Assisted PIFSC staff and the general public in the rescue, rehabilitation, and release of 39 stranded sea turtles during the reporting year. Nine of these turtles required extended rehabilitation in the Life Support System (LSS) tanks at the Daniel K. Inouye Regional Center (IRC). Five of these turtles suffered fishing line entanglement, one of which had a fishing hook in its neck. Four of these turtles required surgical amputation of a front flipper. Another turtle suffered a net entanglement also requiring surgical



Figure 1. JIMAR TRP staff Devon Francke (left) and Sarah Alessi (right) along with NOAA TRP staff Shandell Brunson (center) pose with a green turtle the team successfully rehabilitated after it was found entangled in fishing line near Kihei, Maui. The turtle was flown to Oahu for flipper amputation surgery, and was held in one of the sea turtle rehabilitation tanks at the IRC, until it was given a clean bill of health and released.

amputation of a front flipper. The seventh turtle suffered from fibropapillomatosis (FP) and was assessed to be active and healthy enough for release after being cleaned. The last two turtles suffered from excessive buoyancy, one due to ingestion of terrestrial matter and the other due to a buildup of air in the coelomic cavity. Both of these turtles were treated successfully and released. Daily care of these nine turtles involved feeding,



Figure 2. JIMAR TRP staff Sarah Alessi (left) and Devon Francke (2nd from right) assist NOAA TRP staff Summer Martin (2nd from left), PSD veterinarian Michelle Barbieri (right), and clinical veterinarian Robert Morris (behind Michelle Barbieri) in the surgical front left flipper amputation of an adult male green turtle found near Hickam Air Force Base, Oahu. The surgery was successful, and after two weeks in the rehabilitation tanks at the IRC, the turtle was released at Keehi Beach Park, Oahu.

cleaning tanks, administering medications, assisting the veterinarian and conducting external visual exams.

- Assisted PIFSC staff in conducting 117 necropsies on stranded marine turtles during FY 2015. Salvaged carcasses were examined externally and a gross necropsy was performed to ascertain a cause of stranding. Biological samples such as skin for genetic analysis, food items for diet analysis, and tumor tissue for disease studies were collected and managed by JIMAR TRP stranding associates.
- Conducted a longline observer training session on January 26, 2015. Along with PIFSC staff the JIMAR staff led the presentations and hands-on training, demonstrated the proper techniques for tagging turtles, taking measurements, and collecting a skin biopsy for genetic analysis.
- Participated in field captures of juvenile and sub-adult green turtles on August 27, 2014 at the Kawainui study site in Kailua Bay, Oahu, and at Hanauma Bay, Oahu on January 6 and March 17, 2015. Juvenile green turtles were captured by hand/snorkel or by scoop net and then tagged, measured, weighed, examined and released.
- Joseph Spring, temporary-hire JIMAR TRP Biological Research Associate (May-August 2014), led a 35 day field camp at East Island, French Frigate Shoals (FFS), a major nesting site for Hawaiian green turtles. This was the 41st year of nesting data collection at this site and the 42nd consecutive year of sea turtle nesting surveys performed in the Northwestern Hawaiian Islands (NWHI). A total of 811 nesters were encountered and comprehensively cataloged during monitoring period, an all-time record. Upon



Figure 3. A) JIMAR TRP staff Denise Parker (left) poses with the attendees of the China/USA Sea Turtle Workshop, held in Honolulu, Hawai'i from August 25-29, 2014. B) JIMAR TRP staff Devon Francke (6th from the right), Sara Alessi (7th from the right) and Denise Parker (not pictured) attended the 2015 International Summit on Fibropapillomatosis of Marine Turtles, held from June 11-14, in Honolulu, Hawai'i.

safe return to Honolulu, Mr. Spring completed the post-season analysis of information collected during the 2014 nesting season, including: thorough proofing of the data; finalizing the yearly findings report; updating the Standard Operating Procedures manual; downloading and archiving photos; downloading Global Positioning System (GPS) and temperature logger data; and creating maps and graphs from the data. Currently, temporary-hire JIMAR TRP Biological Research Associate Emma Gosliner is deployed to the FFS performing the 43rd year of data collection.

- Updated and validated entries within the Oracle Turtle Data Processing System (OTDPS). During FY 2015, JIMAR created and updated 1,014 records within the "Stranding," "Nearshore," and "Nesting" databases of OTDPS.
- Facilitated the creation of a sea turtle demographics spreadsheet that summarizes what is known about nesting, hatchlings, growth rates, population dynamics, and survivorship/threats of all sea turtle species in the Pacific Islands Region (PIR). This table will help the TRP identify and prioritize future studies within the PIR to promote the research and conservation of all sea turtle species in the Pacific and serves as a starting basis to search the literature for these future studies.

- Thoroughly inventoried all of TRP's freezers at the IRC, which contained 209 sea turtle samples collected over the last 40 years. A new spreadsheet was created to organize the location of these and thousands of other samples the TRP has collected, consolidating dozens of datasheets into one master database.
- Assisted TRP and NOAA's Pacific Islands Regional Office (PIRO) with a longline sea turtle de-hooking demonstration led by visiting veterinarian, Dr. Mariluz Parga, DVM (SUBMON, Spain). It was a successful collaboration with all groups working alongside longline observers to learn safe techniques to remove fishing hooks from turtles' mouths and flippers.
- Assisted PIFSC TRP with the planning and implementation of two field work days at Hanauma Bay Nature Preserve, Oahu. These field work events were used to assess the sea turtle population within Hanauma Bay and to monitor residency, health, and growth rates of the turtles.
- Assisted with the China/USA Sea Turtle Workshop in August 2014. This workshop, convened under the Living Marine Resources initiative, was attended by scientists from the United States government agencies (NMFS and USGS) as well as top researchers and sea turtle conservationists from throughout China. This meeting included oral presentations by all workshop participants, a necropsy practicum, and field outings to capture live green turtles. To conclude the workshop, the participants developed next steps designed to foster additional dialogue, trust, and collaboration among all workshop participants from across the Pacific Ocean.
- Contributed to the PIFSC Young Scientist Opportunity (PYSO) Committee by assisting in the selection of candidates and the development of projects for this summer internship program for undergraduate scientists.
- Assisted TRP, United States Fish and Wildlife Service (USFWS), and National Institute of Standards and Technology (NIST) in necropsying the remains of 124 green and hawksbill sea turtle nests that had been excavated throughout the Main Hawaiian Islands (MHI). Biological samples were collected to determine genetics, energetics, and pollutants.
- Created three posters and one oral presentation for the 35th Annual Symposium on Sea Turtle Biology and Conservation, held April 19-24, 2015 in Dalaman, Mugla, Turkey.
- Designed and implemented an experiment to test the 'ruggedness' of newly designed solar-powered GPS tags. JIMAR staff tested the tags in varying environmental conditions (dry, wet, covered, and submerged) to determine why the tags were not communicating with the satellites. It was discovered that if the body of the tag was the slightest bit submerged, it could not communicate with the satellite.
- Assisted TRP, United States Geological Survey (USGS), and NIST staff with the necropsies of three leatherback turtles caught as bycatch in the longline fisheries. All samples and information collected from these carcasses were of critical importance as this was the first leatherback necropsy session since 2011.
- Assisted in the funding and travel arrangements for five international visitors to the 2015 International Summit on FP in Marine Turtles, held June 11-14 in Honolulu. The purpose of the summit was to bring together the leaders in FP research from around the globe to discuss the status, trends, and impacts of the disease.
- Provided input and support to researchers from Scripps Institute of Oceanography, the University of Hawai'i, and Deakin University, Australia on three projects that are analyzing different aspects of the pelagic ecology, movement, and habitat use of pelagic loggerheads in the North and South Pacific.

Protected Resources Environmental Compliance Initiative (PRECI)

P.I.: Mark A. Merrifield [JIMAR Project Lead: Karen Frutchey]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Regional Office

NOAA Sponsor: Michael Tosatto, Sarah Malloy

NOAA Goal(s)

· Healthy Oceans

Purpose of the Project

This JIMAR project works to develop and implement strategies to further recover marine species protected under the Endangered Species Act (ESA) and/or the Marine Mammal Protection Act (MMPA), including conduct of Section 7 consultations under the ESA. The project assists in the analysis and procedural requirements to

manage federal fisheries in compliance with the ESA and the MMPA, and develops and delivers outreach and education campaigns for the public concerning protected resources issues.

Progress during FY 2015

Objectives established for this period included sea turtle conservation, management, and fisheries related mitigation activities within PRECI. The JIMAR project staff in the Protected Resources Division (PRD) participated in several workshops and other activities to promote sea turtle conservation and had constructive meetings regarding strengthening partnerships on marine turtle research and conservation with stakeholders in the U.S. Pacific Territories. Continuing as liaison between international marine turtle conservation project principal investigators and PIRO, JIMAR project staff served as a technical monitor for international marine turtle projects in the Federated States of Micronesia (FSM), Cook Islands, Solomon Islands, and French Polynesia in addition to territorial projects in Guam, the Commonwealth of the Northern Marianas Islands (CNMI), and American Samoa. Technical support continued for a marine turtle genetic sampling project in collaboration with NOAA Southwest Fisheries Science Center (SWFSC) scientists to characterize western Pacific green turtle nesting stocks. To advance this research, staff assisted the governments of Guam, American Samoa, FSM, and CNMI with sample organization and Convention on International Trade of Endangered Species (CITES) compliance. In addition, feedback was provided for National Environmental Policy Act documents required to continue collaborative, NOAA-funded marine turtle research and management projects in the western and central Pacific Ocean. Staff assisted the NOAA Monk Seal Program by providing phone support for the monk seal sightings hotline. This allowed staff to engage with the public and provide feedback to interested callers on individual seal status.

JIMAR staff also participated in the review of project progress reports and informal Section 7 consultations. JIMAR led the analysis of permitted research activities within the Papahānaumokuākea Marine National Monument and of potential impacts on sea turtles, monk seals, and cetaceans via ESA Section 7 consultations.

JIMAR continued to maintain a Sea Turtle Reference database for PRD and served as a supporting team member on Section 7 consultations, providing technical assistance to the regulatory team on numerous projects.

As the Climate Change Point of Contact for all of PIRO, PRECI JIMAR staff continued to provide information and guidance on incorporating the effects of climate change into management analyses and identifying gaps in climate science where information would be useful for marine resource management. Project staff also represented PIRO by serving on steering committees and working groups for regional climate change organizations.

Sea Turtle Bycatch and Mitigation Research

P.I.: Mark A. Merrifield [JIMAR Project Lead: Melanie Hutchinson]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Michael P. Seki, Keith Bigelow

NOAA Goal(s)

· Healthy Oceans

Purpose of the Project

Fisheries bycatch has been thought to drive the population declines of numerous marine species. As a result, reducing bycatch of protected species such as sea turtles, sharks, sea birds, and marine mammals is a priority. This JIMAR project researches how to improve the overall selectivity of fishing gear, develop bycatch mitigation strategies for bycatch species, and examine the habitat use of bycatch species to better understand how different fisheries impact these bycatch populations. To accomplish this, project researchers conduct studies examining various Bycatch Reduction Technologies (BRTs). In particular,



Figure 1. Orange LED lights attached to experimental gillnets.

the project examines the use of sensory cues to improve the selectivity of gillnets.

Progress during FY 2015

The use of long wavelength orange LED lights to illuminate gillnets were tested. Experiments in a Mexican coastal gillnet fisheries were completed. Results indicate that orange illuminated nets decreased green sea turtle capture rates while not changing target catch or catch value. These trials represent experiments that were initiated in FY 2014 and completed in FY 2015. In addition, a small study examining the use of Acoustic Deterrent Devices (ADDs) tuned to produce low frequency sound that falls within the hearing range of sea turtles was conducted.

Trials were initiated in the summer of 2014 and are



Figure 2. Ocean Discovery Institute students and project scientists.

ongoing through the summer of 2015. Initial results show a promising 75% reduction of sea turtle interaction rates.

During the reporting period, the project helped expand the use of nets in a small scale gillnet fisheries by initiating experiments in the drift gillnet fisheries based in Peru. Initial findings indicate that short wavelength lights reduce shark bycatch as well as marine mammal bycatch. Experiments were also conducted to examine the effects of net illumination in gillnet fisheries based in Indonesian, Chile, and El Salvador. In addition, satellite tags were deployed on turtles interacting with many of these gillnet fisheries.

Equatorial Oceanography

Research under this theme is associated with the collection and analysis of physical, biological, and chemical observations across the equatorial regions of the Pacific Ocean to yield important information on large-scale ocean dynamics and variability. JIMAR hosts the University of Hawai'i Sea Level Center (UHSLC), which maintains a coordinated network of tide gauge stations and provides sea level data for the oceanographic and climate communities. JIMAR is also home for the Pacific Islands Ocean Observing System (PacIOOS), which is one of 11 regional centers coordinating oceanographic observational data.

Characterization & Dynamics of Mesoscale and Submesoscale Oceanic Variability in the Solomon Sea Simulated by a Nested ROMS Model

P.I.: Mark A. Merrifield

NOAA Office (of the primary technical contact): Pacific Marine Environmental Laboratory

NOAA Sponsor: Christopher Sabine, William S. Kessler

NOAA Goal(s)

· Climate Adaptation and Mitigation

Purpose of the Project

High sea level variability is a prominent feature of the southwest tropical Pacific Ocean where interactions between western boundary currents, equatorial currents and mesoscale processes have the potential to influence the properties of waters upwelled at the equator. While the implications of changing ocean conditions in the equatorial Pacific for ENSO and longer timescale climate variability have long been recognized, the dynamics and origin of enhanced variability in the southwest Pacific are largely unknown. The purpose of this project is to study eddy variability in the Solomon Sea western boundary current system with focus on the meso/submesoscale range (10-200 km) using a high-resolution numerical ocean model supplemented by satellite and in-situ (glider, Argo) data. The project's main objectives are: 1) to characterize the spatial and temporal scales, subsurface



Figure 1. (a) Example of a model velocity snapshot at 600 m showing the formation of eddies by the western boundary current along the Papua New Guinea coast. In particular, anticyclonic eddies are commonly formed past the tips of the Louisiade and Woodlark Archipelagos. Most of this western boundary variability has little to no surface signature. (b) Example of a western boundary generated eddy in Milne Bay sampled by a glider. Grey arrows show the glider-measured vertically-averaged velocity 0-700 m, and blue vectors show the model 0-700 m averaged velocity (note the slightly different scales). The climatologically-forced model simulations cannot be matched to the glider measurements, however, both glider and model show an anticyclonic eddy centered in Milne Bay with similar scale and strength.

structure and evolution of the meso/submesoscale eddies in low latitudes; 2) to diagnose the dynamics of the eddies, including their generation mechanisms and seasonal modulation; and 3) to assess the interactions between the submesoscale, mesoscale and large-scale circulation. The results will inform the physical interpretation of satellite sea surface height observations of these eddies by clarifying their subsurface structures and generations processes.

Progress during FY 2015

During FY 2015 (Year 2 for this project), the project's goal was to build upon its study of eddy variability in the Solomon Sea western boundary current system by focusing on questions of measurability. The model simulations suggest an abundance of active small scale eddies generated at both surface and subsurface. Currently, these small-scales are largely unobservable. Evaluating the temporal evolution and timescales of small eddies from the model will be valuable in determining how to distinguish them from tides in in-situ glider data and in future high-resolution satellite observations of sea surface height. A second objective is to examine in more detail the dynamics of western boundary current variability, including the relative roles of flow-topography interactions and remote process for local eddy generation.

Progress toward these goals was accomplished on several aspects. First, a glider/model comparative study of surface fronts in the Solomon Sea, as represented by the largest surface density gradients, shows similarities in gross features, such as more frequent occurrence of fronts near the Papua New Guinea side of the Solomon Sea and seasonal modulation of the strength of fronts, both of which can be related to the annual cycle of sea surface temperature in the region that dictates when and where large-scale sea surface temperature gradients occur. Most differences in front statistics between model and glider stem from the role of sea surface salinity — while the glider measurements indicate that surface salinity contributes significantly to the horizontal density gradient, this is less so in the project's model, an aspect that needs to be further investigated. Second, within the western boundary current, glider missions have on occasion sampled subsurface eddies with vertical structure similar to that of the western boundary current. A model analysis shows that such eddies are commonly generated by the western boundary current as it flows past topographic obstacles. These eddies have little to no surface signature. Further investigation is needed to determine how the frequency of eddy generation relates to the western boundary current variability further upstream/downstream.


Statistics of density fronts from alongtrack data for the Solomon Sea (glider-sampled region)

Figure 2. Comparison of front statistics from the model using full 2D-fields and along-track data only. The along-track data is collected along a mean glider path (shown on the map, top left). The color contours on the map indicate the fraction of year when density front is present, revealing a drop in front occurrence from the Papua New Guinea (PNG) to the Solomon Islands (SOL) side of the Solomon Sea. Panels (A-E) show statistics computed from the full 2D gradients (in black) and from along-track differences (in red). Similar behavior is described by both except for noisier and reduced magnitude gradient when using along-track data.

Optimizing Routine Ocean Current Measurements by the NOAA Fleet

P.I.: Eric Firing

NOAA Office (of the primary technical contact): Office of Marine and Aviation Operations

NOAA Sponsor: Mark Van Waes

NOAA Goal(s)

• NOAA Enterprise-wide Capabilities: Science and Technology Enterprise; Engagement Enterprise; Organization and Administration Enterprise

Purpose of the Project

The NOAA research fleet includes many ships with acoustic Doppler current profilers (ADCPs). These instruments have the potential to aid a wide variety of NOAA programs using the ships and contribute to the global climatology of ocean current measurements. However, without suitable data acquisition and processing

software installed and used routinely, this potential is not realized. The purpose of this project is for researchers to extend their software knowledge and expertise, gained via years of experience with the academic oceanographic research fleet, to the NOAA fleet.

Progress during FY 2015

The specific goals for the first calendar year were to recruit and train a new Research Associate to specialize in working with the NOAA fleet and to make the project's system operational on approximately five NOAA ships. During this reporting period (partway through the first year of funding) a new employee was hired, a substantial part of the necessary training was completed, and the project's UHDAS system was installed on four ships: *Ron Brown*; *Hi'ialakai*; *Nancy Foster*; and the *Bell Shimada*. All four are included in the project's monitoring system, with automated daily emails (http://currents.soest.hawaii.edu/uhdas_fromships.html). Based on NOAA requirements, standardized computer hardware was selected to be used on present and future installations. Training of NOAA personnel was conducted via a workshop held in San Diego (May 2015) by Dr. Julia Hummon and via remote and onsite contact with ship's officers and technicians. At the request of NOAA personnel, the project developed a new speedlog module as part of the data acquisition system.

The University of Hawai'i Sea Level Center

P.I.: Mark A. Merrifield

NOAA Office (of the primary technical contact): Climate Program Office

NOAA Sponsor: David Legler

NOAA Goal(s)

- Climate Adaptation and Mitigation
- Resilient Coastal Communities and Economies

Purpose of the Project

The purpose of the University of Hawai'i Sea Level Center (UHSLC) project is to ensure that tide gauge data from around the world are collected, quality assessed, distributed, and archived for use in climate, oceanographic, ocean engineering, and geophysical research. While UHSLC assembles time series from a large number of tide gauge stations, the project's primary focus is the set of stations that constitute the Global Sea Level Observing System (GLOSS) and the Global Climate Observing System (GCOS). The GLOSS and GCOS networks cover most major oceanic islands and island chains, with a subset of available continental coastal stations distributed evenly around the margins of ocean basins. Because of their importance for global and regional sea level reconstructions, vertical land motion monitoring is recommended at all GLOSS and GCOS stations and the UHSLC maintains 11 continuous Global Positioning System (GPS) receivers at these stations. A primary objective of the UHSLC is to maintain two tide gauge datasets: the Fast Delivery dataset, which provides preliminary, quality-assured, hourly tide gauge data within 4-6 weeks of collection; and the Research Quality dataset, which is an archive of hourly tide gauge data that have undergone a complete quality assessment generally within one year of collection. The Research Quality database is maintained in collaboration with the National Oceanographic Data Center. The UHSLC acquires tide gauge data from nearly 500 tide gauge stations maintained by 65 international agencies. UHSLC technicians and data analysts collaborate directly with international partners to maintain 80 high profile stations that are important for the global sea level observing effort. UHSLC involvement ensures that research quality datasets are available from otherwise sparsely sampled areas of the global ocean, and that developing nations have access to training, technical support, and data processing services as needed.

Progress during FY 2015

During FY 2015 the project accomplished all its objectives for data management and station operations as the Fast Delivery and Research Quality database were updated and expanded to accommodate new station datasets. GPS installations at tide gauges were maintained with assistance from the Pacific GPS Facility at the University of Hawai'i. These data are provided to the GLOSS TIGA data centre. The project is committed to one new GPS



Figure 1. (a-c) Rates of sea level change from satellite altimetry (Aviso) for different periods in the Indo-Pacific region. (d) The difference in rates between the 1993-2002 and 2003-2012 periods emphasizing the trend reversal spanning the equatorial and northern Indian Ocean (ENIO). (e-h) The same calculations for sea level fields from the GECCO2 data assimilating ocean synthesis. This model is used to diagnose the cause of the sea level variability.



Figure 2. Upper ocean temperature from GECCO2 over the ENIO (red) and time-integrated western boundary volume transport between 7°S and 26°S estimated from the Sverdrup balance (black). This shows that changes in the large-scale wind field over the Indian Ocean account for a reversal in ENIO upper ocean temperature trends, which in turn account for the reversal in satellite-observed sea level trends.

installation at a tide gauge station and anticipates its completion during FY 2016. Plans are underway for the installation of a new station at the GLOSS Chuuk Island site in the Federated States of Micronesia.

Significant progress was made toward FY 2015 research objectives. In particular, a dynamical framework was developed to describe subsurface warming and sea level trends in the Indian Ocean that is part of the global asymmetry in rates of sea level change identified in FY 2014. A manuscript on this topic is almost complete and ready for submission to a peer-reviewed journal. Project researchers identified a reversal in Equatorial and Northern Indian Ocean (ENIO) sea level trends measured by satellite altimeters between the first and second decade of the record (Figure 1b-d). This reversal is also captured by the GECCO2 ocean synthesis (Figure 1f-h), which was utilized to show that the reversal in sea level trends is due to variability in upper ocean temperature related to changes in wind-stress forcing and ocean volume transport over the basin captured by the Sverdrup balance (Figure 2). Progress was also made toward a better understanding of regional sea level change in the CMIP5 model ensemble with a particular focus on the cause of reduced amplitude in Pacific decadal sea level variability relative to observations. This research is not yet complete–primarily due to an expansion of the FY

2015 research scope to include a variety of investigations related to reconstructions of GMSL. In particular, project researchers co-authored an article detailing an investigation into the effect of tide gauge selection on estimates of 20th century GMSL trends. Many GMSL estimates are available in the literature and differences between these estimates are generally attributed to methodological differences. This paper demonstrates that the particular subset of tide gauge records chosen for a given reconstruction can impact results as much–if not more– than methodology. Additional work concerning reconstructions of GMSL is currently underway.

University of Hawai'i Sea Level Center (GNSS installation at NOAA CO-OPS Stations)

P.I.: Mark A. Merrifield, James Foster, Todd Ericksen

NOAA Office (of the primary technical contact): Climate Program Office

NOAA Sponsor: David Legler

NOAA Goal(s)

- Climate Adaptation and Mitigation
- Resilient Coastal Communities and Economies

Purpose of the Project

UH will fabricate and install continuous Global Navigation Satellite System (GNSS) stations at two NOAA Center for Operational Oceanographic Products and Services (CO-OPS) maintained tide gauge sites based on agreed upon NOAA priorities and contingent upon securing necessary permits and permissions. The installed GNSS stations will conform to Global Sea Level Observing System/International GNSS Service-GPS Tide Gauge Benchmark Monitoring station guidelines for continuous and permanent operation, recording daily files of 30 sec sample data transmitted via the best available telemetry.

Progress during FY 2015

The project received preliminary approval to install GNSS stations near the existing tide gauge stations at Midway and Wake Islands. Both sites are considered suitable locations in that they provide stable long-term geodetic measurements of vertical motion. Most of the project equipment necessary for installation was shipped to Midway. The project is currently awaiting final approval of the installation permit and awarding of the new air transportation contract in order to get to the island. Although the project was assured that there won't be any problems finalizing the permit, the process has been a long one as the permit will retroactively include all the existing tide-gauge related equipment, which had not to date been formally included on a permit.

The project received permission to visit Wake Island and install equipment. Once logistics for transporting equipment has been finalized the project can proceed with identifying flights to visit the island and perform the installation.

University of Hawai'i Sea Level Center (Ship-Based Tsunami Detection and Characterization)

P.I.: Mark A. Merrifield, James Foster, Todd Ericksen

NOAA Office (of the primary technical contact): Climate Program Office

NOAA Sponsor: David Legler

NOAA Goal(s)

· Resilient Coastal Communities and Economies

Purpose of the Project

This three-year pilot project will build a network of ten ships providing accurate position solutions for tsunami detection and characterization. The project will equip ten ships operating between North America, Hawai'i and



Figure 1. GPS tsunami detection and characterization package installation on the Matson Navigation container ship M/V Manoa. High-accuracy solutions for the position of the GPS antenna are generated and streamed in real-time via satellite communications to the project server.

Asia with a geodetic Global Positioning System (GPS) installation to measure ship vertical positions to better than 10 cm RMS, and a satellite communications antenna to transmit the data in real-time to processing computers at the University of Hawai'i

Progress during FY 2015

The primary goals and accomplishments for Year 1 of this project are as follows.

Install Geodetic GPS + satellite communications packages on ten container ships operating in the north Pacific. The initial ten-ship plan was slightly modified due to an unexpected increase in satellite communications costs. In order to meet the ten-ship target it was decided to install the project's GPS+ packages on eight commercial ships, and take advantage of two available research vessels, the *R/V Ron Brown*, and *R/V Kilo Moana* as hosts for the final two installations. GPS + Communications packages were installed on two Matson container ships, the *M/V Manoa* and *M/V Maui*, operating between Hawai'i and the west coast of the U.S. There are five fully installed packages on Maersk ships (*Maerk Svendborg*, *Maersk Sine*, *Maersk Soroe*, *Maersk Clifford*, and *Maersk Sovereign*) operating on the North Pacific shipping routes between Panama and Korea. A sixth installation is partially in place and will be completed in one month. The package installation on the *R/V Ron Brown* was completed while it was in port in Hawai'i this January, and the final GPS package installation on the *Kilo Moana* will be completed shortly.

Establish real-time data streams and ship positioning. Project researchers built a beta-version of the software package to collect, process and present the time-series of positions broadcast by the GPS packages on the abovementioned ships. Data streams from all participating ships are now being received by this package.

Install mirror of Pacific Tsunami Warning Center (PTWC) RIFT software with model runs initiated by automatic email from PTWC. The project identified the specifications for a linux workstation that will host a port of the Real-time Inundation Forecast of Tsunamis (RIFT) software to enable the U.S. to produce preliminary models of sea-surface perturbations for any tsunami events in the Pacific. The installation will be finished by the end of this summer.



Figure 2. Snapshot of the 00:00 UTC 14 July 2015 network of reporting ship-based GPS tsunami detection and characterization nodes. Markers indicate current location of each active ship. Inset: One-hour time series of the vertical position solutions for the GPS antenna onboard the container ship Maersk Soroe (indicated by the arrow in the main figure). High frequency changes are due to the motion of the ship on the wave field, while the visible long-period change is due to the topography of the geoid changing the mean elevation of the sea-surface.

Climate Research and Impacts

Oceanic and atmospheric processes drive global and regional climate, and climate change and impacts are associated with changes in these processes as well. Under this theme, JIMAR collaborates in research efforts with the International Pacific Research Center (IPRC) in SOEST, and hosts the Pacific ENSO (El Niño Southern Oscillation) Applications Center (PEAC).

Enhancement of Data and Research Activities for Climate Studies at the International Pacific Research Center (IPRC)

P.I.: Kelvin Richards

NOAA Office (of the primary technical contact): National Environmental Satellite, Data, and Information Service/National Climatic Data Center

NOAA Sponsor: Howard Diamond

NOAA Goal(s)

- Weather-Ready Nation
- Climate Adaptation and Mitigation
- Resilient Coastal Communities and Economies

Purpose of the Project

This project enhances activities at the Asia-Pacific Data-Research Center (APDRC) as well as climate research within the International Pacific Research Center (IPRC) at the University of Hawai'i. The project's overall goals are: (i) to meet critical regional needs for ocean, climate and ecosystem information; (ii) to enhance activities in support of the Global Earth Observation System of Systems (GEOSS) and the NOAA Pacific Climate Information System (PaCIS); (iii) to provide infrastructure in support of follow-on activities to the Global Ocean Data

Assimilation Experiment (GODAE); and (iv) to conduct research to enhance understanding of climate variability and change in the Asia-Pacific region. The vision of the APDRC is to link data management and preparation activities to research activities within a single center and provide one-stop shopping of climate data and products to local researchers and collaborators, the national climate research community, and the public. The APDRC is organized around three main goals: providing integrated data server and management systems for climate data and products; developing and serving new climate-related products for research and applications users; and conducting climate research in support of the IPRC and NOAA research goals.

Progress during FY 2015

There are two main components to this activity: Data Management (DM) and Data Server Systems (DSS). The DM group identifies important datasets from each of three sub-disciplines: oceanographic data, atmospheric data and air-sea flux data. Moreover, the group ensures that on-line data is up to date, well documented, and to a certain extent, quality controlled. Finally, the group also makes recommendations on how to make the data more useful to clients — the value-added component. An additional activity included under data management is user interface development. The user-interface activity focuses on providing an interface between users and the data archives, including maintaining the APDRC web presence. The group makes sure the web pages are user-friendly and up to date and also handles specific, specialized data requests (e.g., email requests) by notifying the appropriate activity within the data management group. Finally, this group fosters co-operation with data serving groups outside the APDRC by providing links to their sites.

The DSS component then ensures the data and products are properly served to the community via the APDRC system. A software-server manager, in collaboration with the IPRC computing facility, maintains all the software programs that comprise the APDRC data server systems. The group installs and upgrades all the server software, ensuring that programs are up to date, and makes sure that the APDRC web links are active and accurate. The group also oversees the day-to-day operation of the server machines and provides all upgrades to these machines. The server management group keeps up to date on new advances in technology (both hardware and software) by attending meetings and workshops and through dialogue with other groups to provide future direction and recommendations for the APDRC computing infrastructure. The group also teams with the IPRC Parallel Computing Facility (PCF) to provide technical support to users.

The APDRC maintains a wide suite of data transport and discovery servers, including: OPeNDAP-based THREDDS DODS Server (TDS), GrADS DODS Server (GDS) and dapper; a Live Access Server (LAS); and Dchart. These servers continue to be maintained and there were no dramatic changes to these services in the past year.

During this reporting period the APDRC supported three main efforts. The first is climate services within NOAA's Pacific Climate Information System (PaCIS). Having set up PaCIS web pages during the previous reporting period, for FY 2015 APDRC personnel added automatically updated "dashboard" pages. John Marra (PaCIS director) participated in many user engagement workshops at various Pacific Islands. Through these meetings, PaCIS was able to identify key climate indicators of particular interest to different sectors, e.g., seasonal predictions of rainfall. APDRC staff provided updated plots and graphs of these climate indicators based on regions (e.g., Republic of the Marshall Islands, Vanuatu, etc.) and sector (e.g., Fresh Water Resources, Coral Reefs, etc.). The dashboards can be found at http://www.pacificcis.org/dashboard/.

Second, the APDRC supported IPRC research activities associated with Pacific climate studies done in collaboration with JAMSTEC. Scientists at the IPRC are working with colleagues at JAMSTEC on various projects that require access to large data sets and also need a mechanism to share their project-generated data. Examples include management of output from the Earth Simulator and output from the CMIP-5 models.

Finally, the APDRC has been working with the Pacific Islands Climate Science Center (PICSC), a USGSfunded effort managed by the IPRC. The PICSC funded projects include high-resolution regional climate models, and APDRC staff provided data management support for these model runs.

Formulation of Localized Sea Level Rise/Coastal Inundation 'Extremes' Scenarios for Pacific Islands

P.I.: Mark A. Merrifield

NOAA Office (of the primary technical contact): National Climatic Data Center

NOAA Sponsor: John Marra

NOAA Goal(s)

- Climate Adaptation and Mitigation
- Resilient Coastal Communities and Economies

Purpose of the Project

This project seeks to develop best practices and methodologies that can be used to formulate probabilistic estimates of extreme sea level events under a changing climate for specific locations in the Pacific Islands. A primary objective is the development of proof-of-concept products in support of decision-making ranging from area-wide vulnerability assessment related to climate adaptation planning and disaster risk reduction to site-specific analysis related to design and maintenance of facilities and infrastructure at select Department of Defense sites. An extreme value distribution analysis is used and applied to long tide gauge records that allow for temporal variations in the location, scale, and shape parameters of the distribution function. These variations can include mean sea level rise and modes of climate variability. The time-varying parameterizations allow for the decomposition of extreme water levels into various components (e.g., tidal versus nontidal, patterns versus trends) that can be recombined for specific locations and time.

Progress during FY 2015

This project culminated in the generation of the guidance document, "Practioner's Guide to the Formulation of Probabilistic Estimates of Sea level Extremes under a Changing Climate". The report describes how to formulate scenario-dependent, probabilistic projections of extreme sea levels based on patterns of regional sea level variability and storminess as well as global and regional sea level rise. It is meant for engineers, scientists, and other practitioners to support decision-making ranging from regional vulnerability assessments to the design and maintenance of facilities and infrastructure. The report presents examples of studies and approaches with an emphasis on the Pacific Islands region.

Mechanisms of Atmospheric Mercury in Transport and Transformation in the Remote Pacific Marine Free Troposphere Measured in Hawai'i

P.I.: Mark A. Merrifield

NOAA Office (of the primary technical contact): Earth System Research Laboratory/Mauna Loa Observatory

NOAA Sponsor: Russell Schnell, Darryl T. Kuniyuki

NOAA Goal(s)

• Weather-Ready Nation

Purpose of the Project

Collection of atmospheric mercury speciation data. The project collects and analyzes semi-continuous high altitude (11,400 feet) measurements of Hg0, RGM, and HgP at the Mauna Loa Observatory (MLO), Hawai'i. The objectives of this task will be to accumulate a long-term record of ambient Hg0, RGM, and HgP chemistry to: (i) support atmospheric mercury chemistry research; (ii) establish a baseline mercury measurement station; and (iii) investigate the long range transport of mercury from South East Asia across the Pacific. In addition to this primary task, other data are measured and collected that may elucidate the transport and transformation mechanisms

of atmospheric mercury. This includes measurements of atmospheric aerosols, ozone, sulfur dioxide, elemental carbon, and meteorological variables. All of the data will be organized and archived in a database. Some data and theories will be placed on the MLO website and other types of media for outreach purposes.

Progress during FY 2015

Activity was centered on conducting additional tests and measurements to remedy and mitigate observed mercury measurement artifacts at MLO. Prior testing at MLO provided conclusive evidence for the presence of Hg0-HgP measurement artifacts in the inlet glassware of the commercial system. In addition, measurement biases in the monitoring of RGM were also identified. A site visit by the project leader on March-April 2015 provided an opportunity to install additional instrumentation and methodologies to measure Hg0 and total mercury, and calculate reactive mercury (RM: RM = RGM + HgP) by difference. Instrumentation will be deployed until Fall 2015 to allow for an assessment of accuracy and potential artifacts and biases of all the different measurement techniques deployed at the site over a variety of conditions. A calibration system for RGM compounds will be deployed in FY 2016 to allow a more quantitative assessment of measurement capabilities under all conditions.



Figure 1. Winston Luke with additional instrumentation for a special test done in 2015.

Actual accomplishments in FY 2015 exceeded planned activities and objectives.

Pacific ENSO Applications Climate Center

P.I.: Mark A. Merrifield

NOAA Office (of the primary technical contact): National Weather Service/Pacific Region Office

NOAA Sponsor: Raymond Tanabe

NOAA Goal(s)

- Weather-Ready Nation
- Climate Adaptation and Mitigation
- Resilient Coastal Communities and Economies

Purpose of the Project

The Pacific ENSO Applications Climate Center (PEAC) conducts research and develops information products on the El Niño–Southern Oscillation (ENSO) climate cycle. PEAC provides ongoing summaries of ENSO forecasts and outlooks of probable ENSO impacts in the US-Affiliated Pacific Islands (USAPI) region related to rainfall, sea level, and tropical cyclone activity. The main objective of PEAC is to provide timely and easily accessible information that supports planning and management activities in climate-sensitive sectors such as water resource management, fisheries, agriculture, civil defense, public utilities, coastal zone management, and other important economic and environmental sectors in the USAPI region.

Progress during FY 2015

A PEAC objective for FY 2015 was to develop and distribute expanded seasonal water level outlooks, which were identified at a recent regional Integrated Water Level Service (IWLS) meeting as being of especially high



Figure 1. El Niño sea level impacts for the USAPI region are apparent in island tide gauge records monitored by PEAC (2014-15). The recent drops in sea level correspond to anomalous westerly winds near the equator during 2014 and 2015. Current ENSO forecasts call for sea level to continue to fall in the western tropical Pacific through 2015.

interest for the Pacific region. To meet the increasing demand for longer lead-time (e.g., 6-12 months) sea level forecasts as well as for forecasts at non-USAPI sites, the PEAC Center developed seasonal sea level forecasts based on regional wind and sea surface temperature patterns for non-USAPI sites in the south Pacific. Recently, nine new tide gauge stations were added to the season-to-annual sea level forecasts below pacific. Recently, runafuti; Penrhyn; Kanton; Christmas; Rarotonga; Papeete; and Rikitea. The forecasts helped to improve long-term response planning for hazard management in the south Pacific region. In addition, the PEAC Center is working closely with IWLS partners, including the NOAA NESDIS National Centers for Environmental Information, International Pacific Research Center, New Zealand National Institute for Water and Atmospheric Research and Met Service, Australia's Bureau of Meteorology, and the Commonwealth Scientific and Distribution Research Center to develop experimental ensemble mean sea level anomaly forecasts for selected Pacific islands. Both statistical and dynamical forecast models are in use.

Another focus area during the reporting period is the development of a new statistical rainfall forecasting scheme for the Hawai'i region. These Canonical Correlation Analysis (CCA) forecast products are used with other dynamical and statistical model outputs to develop a seasonal rainfall outlook for the Hawai'i region.

PMEL-UH Ocean Carbon Project

P.I.: Matthew J. Church

NOAA Office (of the primary technical contact): Pacific Marine Environmental Laboratory

NOAA Sponsor: Christopher Sabine

NOAA Goal(s)

· Healthy Oceans

Purpose of the Project

The primary mission of this project is to evaluate the variability in air-sea CO_2 fluxes by conducting high resolution time-series measurements of atmospheric boundary layer and surface ocean CO_2 partial pressure (*p*CO₂). The Moored Autonomous pCO₂ (MAPCO₂) system collects CO₂ data from surface seawater and marine

boundary air every three hours for up to a year at a time before they need servicing. Daily summary files of the measurements are transmitted back to PMEL where the data are examined and plots of the results are posted to the web in near-real time.

Progress during FY 2015

During the reporting period the project provided two weeks of salary support for a member of the Hawai'i Ocean Time-series (HOT) program staff (Dan Sadler) to oversee maintenance of instrumentation used for remote and shipboard measurements of atmospheric and seawater CO_2 . Sadler oversees installation and testing of instrumentation used as part of NOAA's Pacific Marine Environmental Laboratory (PMEL) measurements of the partial pressure of CO_2 (pCO_2) and pH in the tropical and subtropical Pacific Ocean. His efforts focused on installation and servicing of instruments on the WHOTS mooring, a collaborative mooring program, funded jointly by NOAA and NSF and led by scientists at Woods Hole Oceanographic Institution (WHOI) and the University of Hawai'i. In addition, Sadler assisted with installation, calibration, and servicing of pCO_2 instrumentation on NOAA research vessels working in the equatorial Pacific and Hawaiian waters. Sadler served as the local (Hawai'i-based) liaison between PMEL and the University of Hawai'i. Funds from this award partially offset time devoted by Sadler to these PMEL projects.

Profiling CTD Float Array Implementation and Ocean Climate Research

P.I.: Mark A. Merrifield

NOAA Office (of the primary technical contact): Pacific Marine Environmental Laboratory

NOAA Sponsor: Gregory C. Johnson

NOAA Goal(s)

· Climate Adaptation and Mitigation

Purpose of the Project

JIMAR works with U.S. and International Argo Project partners, especially NOAA/PMEL, on two aspects of the Argo Program. The first objective involves float testing, deployment, and data/engineering evaluation. The second objective involves climate research using data from Argo floats and other sources.

Progress during FY 2015

The project accomplished its stated goals for this reporting period. Dr. Elizabeth Steffen and the PMEL float lab took delivery of 90 Argo floats this year. Dr. Steffen tested floats (Figure 1), monitored float performance, and diagnosed and coordinated repairs of problems discovered with the floats. She also worked with the manufacturer to resolve problems including warranty replacements and developed a simple deployer-float interface. She dealt with switching to a new Iridium service provider, arranged for float deployments, and notified the national and international databases. She traveled to load floats on various ships and train deployers.

Along with JIMAR Senior Fellow Dr. Gregory Johnson, Dr. John Lyman produced and analyzed yearly maps of global upper ocean heat content from 1993 through 2014 (Figure 2), combining in situ thermal data and satellite altimetry data, as well as yearly maps of sea surface salinity from 2005



Figure 1. Dr. Elizabeth Steffen preparing to test PMEL Argo floats.



Figure 2. Upper Ocean (0–700 dbar) Ocean Heat Content Anomaly [10⁹ J m²] for 2014 relative to 1993–2014 estimated using in situ (mostly from Argo in recent years) temperature data and satellite altimeter sea surface height data (in colors, with red being warm and blue cold).

through 2014. They continued working on estimating uncertainties in and improving estimates of, global ocean heat content anomalies and their trends. Dr. Lyman also worked on updating scientific delayed-mode quality control software for the PMEL Argo floats. This year Dr. Lyman was co-author on four journal articles (he was first author on one article, and two are annual *State of the Climate in 2013* report sections). Stated project goals were met.

Seasonal Forecasts and Extreme Event Projections for Pacific Island Sea Level

P.I.: Mark A. Merrifield

NOAA Office (of the primary technical contact): National Climatic Data Center

NOAA Sponsor: John Marra

NOAA Goal(s)

- Weather-Ready Nation
- Resilient Coastal Communities and Economies

Purpose of the Project

This project addresses the need for information on the potential for coastal flooding and erosion. It provides guidance on the formulation of scenario-dependent probabilistic estimates of future extreme sea levels that account for patterns of sea level variability and storminess as well as global and regional sea-level rise. An overarching objective is to generate information pertinent to engineers, scientists, and other practitioners involved in decision-making ranging from area-wide vulnerability assessment related to climate adaptation planning and disaster risk reduction, to site-specific analysis related to design and maintenance of facilities and infrastructure.

Progress during FY 2015

The project contributed to the assembly of extreme sea level information based on a review of published literature, expert input on best practices from two technical workshops attended by national and international experts, and a series of extreme value analyses for specific locations in the Pacific Islands carried out in part

under the U.S. Department of Defense Strategic Environmental Research and Development Program Limited Scope project, Advancing Best Practices for the Formulation of Localized Sea Level Rise/Coastal Inundation "Extremes" Scenarios for Military Installations in the Pacific Islands (RC-2335). The results of this project contributed to the "Practitioner's Guide to the Formulation of Probabilistic Estimates of Sea Level Extremes under a Changing Climate".

Tropical Meteorology

SOEST is uniquely qualified for geophysical research in tropical regimes, and the Department of Atmospheric Sciences provides world-class research in the areas covered under this theme. In addition to facilitating IPRC and Department of Atmospheric Sciences research, JIMAR hosts NOAA National Weather Service fellowship programs in the SOEST academic departments.

National Weather Service Pacific Region Fellowship Program

P.I.: Mark A. Merrifield

NOAA Office (of the primary technical contact): National Weather Service/Pacific Region Office

NOAA Sponsor: Raymond Tanabe

NOAA Goal(s)

Weather-Ready Nation

Purpose of the Project

As part of the memorandum of understanding between the University and the National Weather Service (NWS), the NWS supports graduate students in SOEST academic units.

Progress during FY 2015

During FY 2015, the NWS Fellowship Program provided ongoing educational support to the Geology and Geophysics (G&G), Atmospheric Sciences (formerly Meteorology), and Oceanography departments. The NWS Fellowship funds were used to: 1) support graduate teaching assistantships; 2) provide administrative support via undergraduate student helpers and purchase of scientific software and office research supplies; and 3) provide vessel charter support allowing oceanography graduate students the opportunity to learn hands-on field research techniques off the coast of O'ahu. Students took measurements of the oceanic environment and conducted zooplankton sampling. A UH dive safety officer accompanying the students gave a boat safety information session and exposed students to scientific diving operations.

Two Department of Atmospheric Sciences (DAS) graduate students were supported by the NWS funds. Chris Goodman is working with DAS Professor Jennifer Griswold and just completed his second semester. His focus is on how ENSO and other planetary scale phenomena affect commercial aviation. He is looking at the long-term datasets from various airports to see how the frequencies of such conditions as icing, sleet, strong convection and varying wind direction have changed. All these factors have a major impact on the cost to both the airlines and the passengers who may endure delays.

Andrew Frambach is also a DAS graduate teaching assistant working with DAS Professor Michael Bell and recently completed his second year. Andrew will be giving a talk at the 16th AMS Conference on Mesoscale Processes (August 3-6, 2015, Boston, MA) entitled, "Dual-polarization radar characteristics of convection in Hawai'i observed during HERO". This presentation covers aspects of his thesis, which deals with dual-polarization measurements of clouds in Hawai'i. He was a co-author on a BAMS article authored by Bell and is co-author on a manuscript nearing submission led by Bonnie Brown. The latter paper looks at simulations and data from 2014 Hurricanes Ana (Central Pacific) and Arthur (Atlantic).

Tropical Pacific Testbed (TPT) for GOES-R Application Development

P.I.: Steven Businger

NOAA Office (of the primary technical contact): National Environmental Satellite Data and Information Service

NOAA Sponsor: Steven Goodman

NOAA Goal(s)

• Weather-Ready Nation

Purpose of the Project

The Tropical Pacific Proving Ground (TPPG) for GOES-R application development has brought Polar Orbiting Satellite data to the NWS Pacific Region in Real Time. The high-resolution data serve as a proxy for GOES-R data and facilitates forecaster skills and access to GOES-R tools, resulting in more accurate and timely forecasts and warnings.

Progress during FY 2015

The project is on schedule to meet its goals for the FY. Below is a list of accomplishments.

- Continued to provide oversight and maintenance of the network feed of satellite data to the Pacific Region Headquarters and the NWSFO with assistance from NWS PR and University of Wisconsin (UW) staff.
- Completed Lightning Algorithm and port of Pseudo reflectivity lightning product to AWIPS II.
- Developed and maintained web page to serve polar orbiting satellite imagery to UH students and faculty and the public. See http://mkwc.ifa.hawaii.edu/satellite/polar/.
- Developed new pages for hyper-spectral data and products (Figure 1).
- Developed and worked with NWS PR staff to provide vog aerosol product (Figure 2).



Figure 1. Screen capture of MKWC PW product from derived from CriS instrument.



Figure 2. Vog model output of sulfate aerosol.

- Mentored graduate students using the polar orbiting satellite imagery and data for their research projects.
- Promoted use of high-resolution satellite data and GOES-R products in the class room. Project collaborators during this year include:
- Jordan Gerth–General AWIPS and GOES-R network support;
- Liam Gumley–X/L band network support and data product installation;
- Eric Lau-Facilitation of AWIPS II/training and PRH product integration;
- Wayne Feltz–General satellite training at UW Madison and project facilitation and oversight;
- Mark DeMaria/ Hiro Gosden-AWIPS I localization; and
- · John Porter-development of aerosol algorithm

Tsunamis and Other Long-Period Ocean Waves

JIMAR efforts in tsunami detection include development of monitoring systems for the Indian Ocean. Further collaboration in this theme is affected through interactions with the UHSLC.

Archive of Rapidly Sampled Hawaiian Sea Level

P.I.: Douglas S. Luther

NOAA Office (of the primary technical contact): Pacific Marine Environmental Laboratory

NOAA Sponsor: Christopher Sabine

NOAA Goal(s)

• Weather-Ready Nation

Purpose of the Project

The Archive of Rapidly Sampled Hawaiian Sea Level (ARSHSL) provides an Internet-accessible, public database of rapidly-sampled ($\Delta t \le 6$ minutes) sea level observations from existing Hawaiian coastal sea level gauges maintained by the National Ocean Service (NOS) and the Pacific Tsunami Warning Center (PTWC). The archive was originally established by NOAA in 1997 to ensure a consistent repository for rapidly-sampled sea level in the Hawaiian Islands for the study of weak tsunamis and related infra-gravity wave signals (including edge waves and harbor resonances) at periods of 2-40 minutes. The archive is maintained with funding support through JIMAR. Sea level data from two-thirds of the gauges accessed by the project is not generally available to the public or research communities; that is, the data is not prepared and offered to the public by the agency (PTWC) responsible for maintaining the gauges, because these activities are not part of the mission of that agency. Therefore, this data archiving and dissemination activity provides as complete a dataset as possible of sea level fluctuations at the coasts of the Hawaiian Islands for current and future research and practical applications. Past applications of the archived data have ranged from hydrogeology to gravity wave studies to dock design. Predominant users in the past year focused on infragravity waves at periods of 2 minutes to several hours in support of the development of both harbor surge and beach flooding "nowcasts" and forecasts for NOAA's PacIOOS. PacIOOS and JIMAR continued funding support of graduate student Assaf Azouri, who is analyzing the 13 years of PTWC sea level data from Haleiwa Harbor in ARSHSL to determine the relationships between Haleiwa's suite of infragravity wave fluctuations and their many forcing pathways (e.g., wind-generated swell directly forcing harbor infragravity waves; versus, swell forcing coastal infragravity waves that then force harbor infragravity waves). Mr. Azouri began working with PacIOOS product developers (especially Dr. Martin Guiles) to create and refine a product* for PacIOOS that will forecast the occurrence of potentially damaging infragravity wave currents in Haleiwa Harbor up to a few days into the future. This work will be extended to other harbors, using the archived high-resolution sea level data in ARSHSL to establish the initial set of parameters of the transfer function from swell to harbor infragravity waves.

* http://oos.soest.hawaii.edu/pacioos/data_product/harborsurge/index.php

Progress during FY 2015

Per the plans for this past year, the ARSHSL has been maintained online (http://ilikai.soest.hawaii.edu/arshsl/ techrept/arshsl.html) by M. Luther and D. Luther in collaboration with the NOAA-funded UH Sea Level Center (M. Merrifield, Director). One-minute and six-minute data from six NOS gauges are retrieved from NOAA's Tides and Currents website (http://tidesandcurrents.noaa.gov/), rather than through the special communications pathways originally established for ARSHSL. In the past, PTWC sea level gauge data ($\Delta t \le$ two minutes) have been automatically or, if necessary, manually downloaded via Internet and telephone links from up to 14 PTWC gauges (in 12 harbors). Lately, however, archiving of new observations from the PTWC gauges has been interrupted due to changes in the telemetry systems at the gauges (previously reported) and the demise of the principal computer employed for executing both automatic data downloading and data editing at the University of Hawai'i. A replacement computer was acquired in Spring 2015 and configured with improved scripts for both the data downloading and editing activities. Acquisition of data from NOS gauges was then re-established; data acquisition from PTWC gauges is still offline.

The University of Hawaii Sea Level Center—Tsunami Research

P.I.: Mark A. Merrifield

NOAA Office (of the primary technical contact): NOAA Tsunami Program

NOAA Sponsor: Michael Angove

NOAA Goal(s)

· Resilient Coastal Communities and Economies

Purpose of the Project

The University of Hawaii Sea Level Center (UHSLC) maintains nine water level stations in the Caribbean Sea and ten water level stations in the Pacific Ocean in support of regional tsunami warning and sea level monitoring. The Caribbean portion of the project is in collaboration with Dr. Victor Huerfano, the Director of the Puerto Rico Seismic Network (PRSN). The UHSLC oversees the operation of the stations and provides ongoing technical support, and data processing and quality assessment services. The Pacific portion of the project is primarily focused on the maintenance of tsunami water level stations previously maintained by the Pacific Tsunami Warning Center (PTWC). UHSLC is working with PTWC and the West Coast and Alaska Tsunami Warning Center (WCATWC) on network priorities and station selection. UHSLC involvement ensures that the water level stations will comply with global sea level observing system requirements for oceanographic and climate research.

Progress during FY 2015

During FY 2015, the UHSLC staff assisted with the operation and maintenance of 19 tide gauge stations that contribute to the tsunami warning systems of the Pacific basin and Caribbean region. UHSLC researchers are examining the spectral character of the sea level records from these and other UHSLC stations to determine the extent of local, resonant excitation of low frequency motions that may enhance the impacts of tsunamis and meteotsunamis.

JIMAR Publications

Author(s) Name	Publication Date	Title	Published In (Journal Name, volume and page number)	Type of Publication	Citation No. or hyperlink	Project Title
Abecassis, M., J. Polovina, et al.		Characterizing a foraging hotspot for short-finned pilot whales and Blainville's beaked whales off the west side of the Island of Hawai'i with tagging and oceanographic data	PLOS ONE	Journal Article	In review	Ecosystem Modeling
Abecassis, M., J. Polovina, et al.	9/4/14	Characterizing an ecosystem hotspot in Hawaii	Symposium on Kona's (West Hawai'i) Marine Ecosystem: Trends and Status, Kailua-Kona, HI, Sept. 4-5, 2014	Presentation		Ecosystem Modeling
Abecassis, M., J. Polovina, et al.	1/15/15	Habitat modeling for two cetacean species within the Kona IEA	NOAA FATE Meeting (Fisheries and the Environment), La Jolla, CA, Jan. 15-16, 2015	Presentation		Ecosystem Modeling
Balazs G., D. Parker, J. Gorman, J. Luecke, and J. Pawloski	6/12/15	Settling down in Hawaii: Adaptation of captive- bred green turtles (<i>Chelonia myda</i>) released from the Maui Ocean Center	Marine Turtle Newsletter, 145, 22-26	Journal Article	http://www. seaturtle.org/mtn/ PDF/MTN145.pdf	Marine Turtle Research Program
Balazs, G.H., M. Rice, D. Parker, and J. Polovina	4/24/15	Ships of opportunity: Releasing satellite-tagged loggerheads on the highseas to study their pelagic ecology	Kaska, Y., B. Sonmez, O. Turkecan, and C. Sezgin, (eds.), Book of Abstracts of 35th Annual Symposium on Sea Turtle Biology and Conservation, MACART Press, Turkey	Conference Proceedings		Marine Turtle Research Program
Bell, M.M., R. Ballard, M. Bauman, A. Foerster, A. Frambach, K. Kosiba, WC. Lee, S. Rees, and J. Wurman	in press	The Hawaiian Educational Radar Opportunity (HERO)	Bulletion of the American Meteorological Society	Journal Article		National Weather Service Pacific Region Fellowship Program (MET)
Brooke, S., D. Graham, T. Jacobs, C. Littnan, M. Manuel, and R. O'Conner	in press	Testing marine conservation applications of unmanned aerial systems (UAS) in a remote marine protected area	Journal of Unmanned Vehicle Systems	Journal Article		Sustaining Healthy Coastal Ecosystems
Businger, S., R. Huff, K. Horton, A.J. Sutton, and T. Elias	in press	Observing and forecasting vog dispersion from Kīlauea Volcano, Hawaiʻi	Bulletion of the American Meteorological Society	Journal Article		Tropical Pacific Testbed (TPT) for GOES-R Application Development
Businger, S., S. Yildiz, and T.E. Robinson	2015	The impact of hurricane force wind fields on the North Pacific Ocean environment	Weather and Forecasting, 30, 742-753	Journal Article	http://dx.doi. org/10.1175/ WAF-D-14-00107.1	Tropical Pacific Testbed (TPT) for GOES-R Application Development
Carvalho, F., and G. DiNardo	12/1/14	Standardized catch rates of shortfin mako shark (<i>Isurus oxyrinchus</i>) caught by the Hawaii- based pelagic longline fleet (2002-2013)	ISC Shark Working Group, Puerto Vallarta, Jalisco, Mexico, Nov. 19-26, 2014, ISC/14/ SHARKWG/10	Workshop Proceedings	http://isc.ac.affrc. go.jp/pdf/ SHARK/ISC14_ SHARK_3/10_ Carvalho- DiNardo_Hawaii_ Standardized_ CPUE.pdf	Stock Assessment Research Program

Carvalho, F., H.H. Lee, Y. Chang, and G. DiNardo	12/1/14	Developing and testing a state-space production model for the shortfin mako shark in the North Pacific Ocean	ISC Shark Working Group, Puerto Vallarta, Jalisco, Mexico, Nov. 19-26, 2014, ISC/14/ SHARKWG/13	Workshop Proceedings		Stock Assessment Research Program
Carvalho, F., R. Ahnrens, D. Murie, et al.	3/5/15	Using pop-up satellite archival tags to inform selectivity in fisheries stock assessment models: a case study for the blue shark in the South Atlantic Ocean	ICES Journal of Marine Science, 16 pp	Journal Article	doi: 10.1093/ icesjms/fsv026	Stock Assessment Research Program
Chang Y.J., J. Brodziak, J. O'Malley, H.H. Lee, G. DiNardo, and C.L. Sun	6/1/15	Model selection and multi-model inference for Bayesian surplus production models: A case study for Pacific blue and striped marlin	Fisheries Research, 166, 129-139	Journal Article		Stock Assessment Research Program
Chang, Y.J., B. Langseth, A. Yau, and J. Brodziak	5/1/15	Stock assessment update for striped marlin in the Western and Central North Pacific Ocean through 2013	ISC Billfish Working Group, Yokohama, Japan, April 20- 28, 2015, ISC/15/ BILLWG-2	Workshop Proceedings	http://isc.ac.affrc. go.jp/pdf/BILL/ ISC_15_BILL-2/ ISC_15_BILL-2_ WP02_final.pdf	Stock Assessment Research Program
Chang, Y.J., W.A. Walsh, and J. Brodziak	5/1/15	Updated operational information and descriptive catch statistics for striped marlin <i>Kajikia</i> <i>audax</i> in the Hawaii- based pelagic longline fishery	ISC Billfish Working Group: Honolulu, HI. January 13-20, 2015, ISC/15/BILLWG-1/02	Workshop Proceedings	http://isc.ac.affrc. go.jp/pdf/BILL/ ISC_15_BILL-1/ ISC_15_BILL- 1_WP02.pdf	Stock Assessment Research Program
Chowdhury, M. R., and P-S. Chu	3/1/15	Sea level forecasts and early-warning application: Expanding cooperation in the South Pacific	Bulletion of the American Meteorological Society, 96, 3, 381-386	Journal Article	doi: http://dx.doi. org/10.1175/	Pacific ENSO Applications Center (PEAC)
Chowdhury, M.R.	10/22/14	Advanced climate research to operations: Experience from the Pacific Islands	9th International Forum on Strategic Technology, Chittagong, Bangladesh, Oct. 21-23, 2014	Presentation		Pacific ENSO Applications Center (PEAC)
Chowdhury, M.R.	1/7/15	Sea level forecasts and early warning application in the Pacific (Session 5: Modelling and data assimilation transitions from research to operations)	95th Annual Meeting, American Meterological Society, Phoenix, AZ, Jan. 4-8, 2015	Presentation		Pacific ENSO Applications Center (PEAC)
Chowdhury, M.R.	3/25/15	ENSO research to operations: Experience from the Pacific Islands	Pacific Risk Management 'Ohana (PRiMO) Conference, The Rising Pacific: Currents of Change and Solutions for Resilience, Panel Session on ENSO, Honolulu, HI, Mar. 24-26, 2015	Presentation		Pacific ENSO Applications Center (PEAC)
Chowdhury, M.R.	4/23/15	The importance of ENSO information in water resources management	Water Resources Research Center Seminar, University of Hawaii at Manoa, Honolulu, HI, April 23, 2015	Presentation		Pacific ENSO Applications Center (PEAC)
Chowdhury, M.R., A. Ludert, and C. Noblitt	8/20/14	An update of El Niño 2014: Global and regional perspectives	Special Seminar at NOAA Inouye Regional Center, Honolulu, HI, Aug. 20, 2014	Presentation		Pacific ENSO Applications Center (PEAC)

Choy, C.A., P.A. Woodworth- Jeffcoats, et al.	10/1/14	Projected responses of the central North Pacific pelagic ecosystem to climate-induced changes in micronekton	PICES Annual Meeting of the North Pacific Marine Science Organization, Yeosu, Korea, Oct. 16-26, 2014	Presentation		Ecosystem Modeling
Copeland, A., W. Au, et al.	9/4/14	Investigating the relationship between foraging odontocetes and ocean acoustic biomass off the Kona coast of the Island of Hawaii	Symposium on Kona's (West Hawai'i) Marine Ecosystem: Trends and Status, Kailua-Kona, HI, Sept. 4-5, 2014	Presentation		Ecosystem Modeling
Copeland, A., W. Au, et al.	5/27/15	Comparison of acoustic biomass and top-predator distribution in the Northwestern Hawaiian Islands	ICES Symposium on Marine Ecosystem Acoustics (Some Acoustics), Nantes, France, May 25-28, 2015	Presentation		Ecosystem Modeling
Coral Reef Ecosystem Division, Pacific Islands Fisheries Scince Center, NOAA Fisheries	4/2/15	Pacific Reef Assessment and Monitoring Program. Fish monitoring brief: American Samoa 2015	PIFSC Data Report, DR-15-008, 2 pp	Report	http://www.pifsc. noaa.gov/library/ pubs/DR-15-008. pdf	Ecosystem Observations and Research Program
Coral Reef Ecosystem Division, Pacific Islands Fisheries Scince Center, NOAA Fisheries	6/2/15	Pacific Reef Assessment and Monitoring Program. Fish monitoring brief: Pacific Remote Island Areas 2015	PIFSC Data Report, DR-15-012, 2 pp	Report	http://www.pifsc. noaa.gov/library/ pubs/DR-15-012. pdf	Ecosystem Observations and Research Program
Costa, B., M.S. Kendall, F. Parrish, J. Rooney, R.C. Boland, M. Chow, J. Lecky, A. Montgomery, and H. Spalding	7/8/15	Identifying suitable locations for mesophotic hard corals offshore of Maui, Hawaii	PLOS ONE, July 8, 2015	Journal Article	doi: 10.1371/ journal. pone.0130285	Sustaining Healthy Coastal Ecosystems
DeCarlo, T.M., A.L. Cohen, H.C. Barkley, Q. Cobban, C. Young, K.E. Shamberger, R.E. Brainard, and Y. Golbuu	11/14/14	Coral macrobioerosion is accelerated by ocean acidification and nutrients	Geology, 43, 1, 7-10	Journal Article	http://geology. gsapubs.org/ content/43/1/7, DOI: 10.1130/ G36147.1	Sustaining Healthy Coastal Ecosystems
Ehses, J.S., and J.J. Rooney	6/11/15	Depth derivation using multispectral WorldView-2 satellite imagery	U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA- TM-NMFS-PIFSC-46, 24 pp	Report	http://www. pifsc.noaa.gov/ library/pubs/tech/ NOAA_Tech_ Memo_PIFSC_46. pdf, DOI: 10.7289/ V5668B40	Sustaining Healthy Coastal Ecosystems
Enochs, I.C., et al. [C. Young and S.J. Clark]	8/10/15	Shift from coral to macroalgae dominance on a volcanically acidified reef	Nature Climate Change	Journal Article	doi: 10.1038/ nclimate2758	Sustaining Healthy Coastal Ecosystems
Gorospe, K., K. Chanon, C.D. Elvidge, P. Lynch, W.L. Michaels, and S. Wongbusarakum	3/5/15	Science and technology to promote sustainable fisheries in Southeast Asia and the Coral Triangle	NOAA Fisheries Pacific Science Center, PIFSC Special Publication, SP-15- 002, 66 pp	Report	http://www.pifsc. noaa.gov/library/ pubs/SP-15-002.pdf	Sustaining Healthy Coastal Ecosystems
Gove, J., G.J. Williams, M.A. McManus, S.J. Clark, J.S. Ehses, and L.M. Wedding	3/2/15	Coral reef benthic regimes exhibit non- linear threshold responses to natural physical drivers	Marine Ecology Progress Series 522, 33-48	Journal Article	http://www.int- res.com/articles/ meps2015/522/ m522p033.pdf, DOI: 10.3354/ meps11118	Sustaining Healthy Coastal Ecosystems

Grace-McCaskey, C.A.	2/20/15	American Samoa fishing community profile: 2013 update	Pacific Islands Fisheries Science Center Administrative Report H-15-04, 30 pp	Journal Article	doi: 10.7289/ V5W66HQ4	Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific
Hamlington, B. D., and P. R. Thompson	5/28/15	Considerations for estimating the 20th century trend in global mean sea level	Geophysical Research Letters, 42, 10, 4102- 4109	Journal Article	doi: 10.1002/2015 GL064177	The University of Hawaii Sea Level Center
Hamlington, B. D., R. R. Leben, KY. Kim, R. S. Nerem, L. P. Atkinson, and P. R. Thompson	6/3/15	The effect of the El Niño- Southern Oscillation on U.S. regional and coastal sea level	Journal of Geophysical Research-Oceans, 120, 6, 3970-3986	Journal Article	doi: 10.1002/2014 JC010602	The University of Hawaii Sea Level Center
Heenan, A., K. McCoy, J. Asher, P. Ayotte, K. Gorospe, A. Gray, K. Lino, J. Zamzow, and I. Williams	2/13/15	Ecological monitoring 2014—stationary point count surveys of reef fishes and benthic habitats of the Northwestern Hawaiian Islands, Mariana Islands, and Wake Atoll	Pacific Islands Fisheries Science Center, PIFSC Data Report, DR-15-001, 101 pp	Report	http://www.pifsc. noaa.gov/library/ pubs/DR-15-001. pdf	Sustaining Healthy Coastal Ecosystems
Heenan, A., et al.	4/22/15	A climate-informed, ecosystem approach to fisheries management	Marine Policy, 57, 182-192	Journal Article	http://www. sciencedirect. com/science/article/ pii/S0308597 X15000676#, doi: 10.1016/j. marpol.2015.03.018	Sustaining Healthy Coastal Ecosystems
Hill, M.C., et al.	2/27/15	Cetacean monitoring in the Mariana Islands Range Complex, 2014	Pacific Islands Fisheries Science Center, PIFSC Data Report DR-15-003, 61 pp + Appendices	Report	http://www.pifsc. noaa.gov/library/ pubs/DR-15-003. pdf	Cetacean Research Program
Hill, M.C., A.D. Ligon, M.H. Deakos, A.C. Ü, A. Milette- Winfree, A.R. Bendlin, and E.M. Oleson	9/2/14	Cetacean surveys in the waters of the southern Mariana Archipelago (February 2010-April 2014).	Pacific Islands Fisheries Science Center, PIFSC Data Report DR-14-013, 49 pp + Appendix	Report	http://www.pifsc. noaa.gov/library/ pubs/DR-14-013. pdf	Cetacean Research Program
Johanos, T.C., A.L. Harting, T.A. Wurth, and J.D. Baker	7/2014	Range-wide movement patterns of Hawaiian monk seals	Marine Mammal Science, 30, 3, 1165- 1174	Journal Article	doi: 10.1111/ mms.12084	Hawaiian Monk Seal Research Program
Johanos, T.C., A.L. Harting, T.A. Wurth, and J.D. Baker	2/2015	Range-wide patterns in Hawaiian monk seal movements among islands and atolls	NOAA Technical Memorandum NOAA- TM-NMFS-PIFSC-44, 26 pp	Report	doi: 10.7289/ V5FT8J02	Hawaiian Monk Seal Research Program
Johnson, G. C., and J. M. Lyman	10/5/14	Oceanography: Where's the heat?	Nature Climate Change, 4, 956-957	Journal Article	http://www.nature. com/nclimate/ journal/v4/n11/full/ nclimate2409.html	Profiling CTD Float Array Implementation and Ocean Climate Research
Johnson, G.C., J.M. Lyman, G.S.E. Lagerloef, and H Y. Kao	7/1/14	Global Oceans: Sea surface salinity [in: "State of the Climate in 2013"]	Bulletion of the American Meteorological Society, 95, 7, S60-S62	Journal Article	http://dx.doi.org/10. 1175/2014BAMSSt ateoftheClimate.1	Profiling CTD Float Array Implementation and Ocean Climate Research
Johnson, G.C., J. M. Lyman, J.K. Willis, T. Boyer, J. Antonov, S.A. Good, C.M. Domingues, and N. Bindoff	7/1/14	Global Oceans: Ocean heat content [in: "State of the Climate in 2013"]	Bulletion of the American Meteorological Society, 95, 7, 860-862	Journal Article	http://dx.doi.org/10. 1175/2014BAMSSt ateoftheClimate.1	Profiling CTD Float Array Implementation and Ocean Climate Research
Kalberg, K., and M. Pan	6/18/14	2012 Economic cost- earnings of pelagic longline fishing in Hawaii	116th Scientific and Statistical Committee Meeting, Honolulu, HI, June 18, 2014	Presentation		Economics of Fisheries Initiative

Kaufman, A.	6/16/15	Beyond sample management: The power of Freezerworks as a research tool for Hawaiian monk seal conservation	Freezerworks Users Education Conference, Las Vegas, NV, June 16-18, 2015	Presentation		Hawaiian Monk Seal Research Program
Kessler, W.S., and H.G. Hristova	7/6/15	Interpreting glider observations in the Solomon Sea	Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (LEGOS), Toulouse, France	Presentation		Characterization and Dynamics of Mesoscale and Submesoscale Oceanic Variability in the Solomon Sea Simulated by a Nested ROMS Model
Kobayashi, D.R., R. Farman, J.J. Polovina, D.M. Parker, M.H. Rice, and G. Balazs	8/16/14	Going with the flow or not: Evidence of positive rheotaxis in oceanic juvenile loggerhead turtles (<i>Caretta caretta</i>) in the South Pacific Ocean using satellite tags and ocean circulation data	PLOS ONE, 9, 8, e103701	Journal Article	doi:10.1371/journal. pone.0103701	Marine Turtle Research Program
Kolinski, S.P., J. Cruce, D.M. Parker, G.H. Balazs, and R. Clarke	1/1/15	Migrations and conservation implications of post-nesting green turtles from Gielop Island, Ulithi Atoll, Federated States of Micronesia	Micronesica, 2014- 04, 9 p	Journal Article	http://www.pifsc. noaa.gov/library/ pubs/Kolinski_etal_ Micronesica_2015. pdf	Marine Turtle Research Program
Kotowicz, D.M.	6/16/15	Decision making and food security in distribution channels for longline-caught tuna in Hawai'i	International Symposium on Society and Resource Management (ISSRM), Charleston, SC, June 13-18, 2015	Presentation		Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific
Kotowicz, D.M., and S.D. Allen	April 2015	Results of a survey of CNMI and Guam residents on the Marianas Trench Marine National Monument	Pacific Islands Fisheries Science Center, PIFSC Data Report, DR-13-009, 55 pp	Report	http://www.pifsc. noaa.gov/library/ pubs/DR-13-009. pdf	Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific
Lewison, R., A.J. Hobday, et al.	3/11/15	Dynamic ocean management: Identifying the critical ingredients of dynamic approaches to ocean resource management	BioScience, 65, 5, 486-498	Journal Article	http://bioscience. oxfordjournals.org/ content/65/5/486, doi: 10.1093/biosci/ biv018	Ecosystem Modeling
Ludert, A., and C. Noblitt	2014	An update of El Niño 2014: Global and regional perspectives	Special Seminar at NOAA Inouye Regional Center, Honolulu, HI, Oct. 23, 2014	Presentation		Pacific ENSO Applications Center (PEAC)
Ludert, A., and C. Noblitt	2015	El Niño update	Special Seminar at NOAA Inouye Regional Center, Honolulu, HI, Jan. 1, 2015	Presentation		Pacific ENSO Applications Center (PEAC)
Ludert, A., and C. Noblitt	2015	ENSO update and seasonal outlook	Special Seminar at NOAA Inouye Regional Center, Honolulu, HI, Feb. 2, 2015	Presentation		Pacific ENSO Applications Center (PEAC)
Lyman, J. M., and G. C. Johnson	2/25/15	Anomalous eddy heat and freshwater transport in the Gulf of Alaska	Journal of Geophysical Research, 120, 2, 1397-1408	Journal Article	http://onlinelibrary. wiley.com/doi/10. 1002/2014JC010 252/abstract	Profiling CTD Float Array Implementation and Ocean Climate Research

Marra, J.J., M.A. Merrifield, and W. Sweet	2015	Advancing best practices for the formulation of localized sea level rise/coastal inundation "extremes" scenarios for military installations in the Pacific Islands	U.S. Department of Defense, Strategic Environmental Research and Development Program, Limited Scope Report (LSR) RC-2335	Report		Seasonal Forecasts and Extreme Event Projections for Pacific Island Sea Level
Martien, K.K., M.C. Hill, A.M. VanCise, K.M. Robertson, S.M. Woodman, L. Dolar, V.L. Pease, and E.M. Oleson	8/1/14	Genetic diversity and population structure in four species of cetaceans around the Mariana Islands	U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA- TM-SWFSC-536	Report	https://swfsc.noaa. gov/publications/ TM/SWFSC/ NOAA-TM-NMFS- SWFSC-536.pdf	Cetacean Research Program
McCoy, K., I. Williams, and A. Heenan	5/15/15	A comparison of rapid visual assessments and photo-quadrat analyses to monitor coral reef habitats	Pacific Islands Fisheries Science Center, PIFSC Data Report, DR-15-011, 13 pp + Appendix	Report	http://www.pifsc. noaa.gov/library/ pubs/DR-15-011. pdf	Sustaining Healthy Coastal Ecosystems
McCoy, K., P. Ayotte, A. Gray, K. Lino, B. Schumacher, and M. Sudnovsky	3/20/15	Coral reef fish biomass and benthic cover along the north coast of Timor-Leste based on underwater visual surveys in June 2013	Pacific Islands Fisheries Science Center, PIFSC Data Report, DR-15-004, 18 pp + Appendices	Report	http://www.pifsc. noaa.gov/library/ pubs/DR-15-004. pdf	Sustaining Healthy Coastal Ecosystems
McGregor, S., A. Timmermann, M.F. Stuecker, M.H. England, M. Merrifield, FF. Jin, and Y. Chikamoto	8/3/14	Recent Walker circulation strengthening and Pacific cooling amplified by Atlantic warming	Nature Climate Change, 4, 888-892	Journal Article	doi:10.1038/ nclimate2330	The University of Hawaii Sea Level Center
Merrifield, M., M. Lander, A. Ludert, and C. Noblitt	5/11/15	El Niño 2015	UHM Special Symposium, C-More Hale Conference Center, Honolulu, HI, May 11, 2015	Presentation		Pacific ENSO Applications Center (PEAC)
Merrifield, M.A., et al. [P.R. Thompson]	7/12/14	[Global oceans] Sea level variability and change [in "State of the Climate in 2013"]	Bulletion of the American Meteorological Society, 95, 7, S71-S73	Journal Article	doi:10.1175/2014 BAMSStateofthe Climate.1BAMSSta teoftheClimate.1	The University of Hawaii Sea Level Center
Montambault, J.R., et al. [S. Wongbusarakum]	6/2/15	Use of monitoring data to support conservation management and policy decisions in Micronesia	Conservation Biology, June 2, 2015	Journal Article	doi: 10.1111/ cobi.12542	Sustaining Healthy Coastal Ecosystems
Morioka, J., R. Reardon, K. O'Brien, J. Garriques, T. Acoba, K. Reardon, and M. Manuel	in press	Marine debris removal and assessment in the Northwestern Hawaiian Islands 2014	PIFSC internal report	Report		Sustaining Healthy Coastal Ecosystems
Noblitt, C.	3/10/15	El Niño update	Special Seminar, National Weather Service Office, Pago Pago, American Samoa, March 10, 2015	Presentation		Pacific ENSO Applications Center (PEAC)
Noblitt, C.	4/13/15	Current state of ENSO	Special Seminar, Climate Env. Security Asia Pacific Region, East-West Center, Honolulu, HI, April 13, 2015	Presentation		Pacific ENSO Applications Center (PEAC)
Pan, M., and K. Kalberg	4/28/15	Economic performance of Hawaii longline 2005- 2014	Hawaii Longling Catch Shares Information Meeting, Western Pacific Regional Fishery Management Council, Honolulu, HI, April 28, 2015	Presentation		Economics of Fisheries Initiative

Parker, D.M., et al.	4/24/15	China-USA 2014 Workshop in Hawaii: Moving forward into the future with trust and friendship to advance sea turtle research and conservation	Kaska, Y., B. Sonmez, O. Turkecan, and C. Sezgin, (eds.), Book of Abstracts of 35th Annual Symposium on Sea Turtle Biology and Conservation, MACART Press, Turkey	Conference Proceedings		Marine Turtle Research Program
Richmond, L., and D. Kotowicz	1/29/15	Equity and access in marine protected areas: The history and future of 'traditional indigenous fishing' in the Marianas Trench Marine National Monument	Applied Geography, 59, 117-124	Journal Article	doi: 10.1016/j. apgeog.2014.11.007	Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific
Richmond, L., D. Kotowicz, and J. Hospital	1/29/15	Monitoring socioeconomic impacts of Hawai'i's 2010 bigeye tuna closure: Complexities of local management in a global fishery	Ocean and Coastal Management, 106, 87-96	Journal Article	doi: 10.1016/j. ocecoaman.2015. 01.015	Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific
Saito, M., M. Kurita, H. Okamoto, I. Uchida, D. Parker, and G. Balazs	6/22/15	Tracking male loggerhead turtle migrations around southwestern Japan using satellite telemetry	Chelonian Conservation and Biology, 14, 1, 82-87	Journal Article	doi:10.2744/ccab- 14-01-82-87.1	Marine Turtle Research Program
Schumacher, B., and B. Vargas-Angel	2/3/15	Reefs for the future: Resilience of coral reefs in the main Hawaiian Islands	Pacific Islands Fisheries Science Center, PIFSC Special Publication, SP-15- 001, 2 pp	Report	http://www.pifsc. noaa.gov/library/ pubs/SP-15-001.pdf	Sustaining Healthy Coastal Ecosystems
Sippel, T., F. Carvalho, et al.	3/1/15	Using movement data from electronic tags in fisheries stock assessment: A review of models, technology and experimental design	Fisheries Research, 163, 152-160	Journal Article		Stock Assessment Research Program
Sun, C.L., H.Y. Chang, T.Y. Liu, S.Z. Yeh, and Y.J. Chang	June 2015	Reproductive biology of the black marlin, Istiompax indica, off southwestern and eastern Taiwan	Fisheries Research, 166, 12-20	Journal Article		Stock Assessment Research Program
Tagami, D., and H. Wang	1/13/15	Spatial distribution of striped marlin catches in the North Pacific from WCPFC data	ISC Billfish Working Group, Honolulu, HI, January 13-20, 2015, ISC/15/BILLWG-1/12	Workshop Proceedings	http://isc.ac.affrc. go.jp/pdf/BILL/ ISC_15_BILL-1/ ISC_15_BILL- 1_WP12.pdf	Ecosystem Observations and Research Program
Taylor, B., P. Houk, G. Russ, and J. Choat	7/4/14	Life histories predict vulnerability to overexploitation in parrotfishes	Coral Reefs, 33, 869- 878	Journal Article	doi: 10.1007/ s00338-014-1187-5	Bio-Sampling
Taylor, B., S. Lindfield, and J. Choat	9/16/14	Hierarchical and scale- dependent effects of fishing pressure and environment on the structure and size distribution of parrotfish communities	Ecography, 38, 520- 530	Journal Article	doi: 10.1111/ ecog.01093	Bio-Sampling
Thompson, P. R., and M. A. Merrifield	11/12/14	A unique asymmetry in the pattern of recent sea level change	Geophysical Research Letters, 41, 7675-7683	Journal Article	doi: 10.1002/2014 GL061263	The University of Hawaii Sea Level Center
Walsh, W.A., and J. Brodziak	June 2015	Billfish CPUE standardization in the Hawaii longline fishery: Model selection and multimodel inference	Fisheries Research, 166, 151-162	Journal Article		Stock Assessment Research Program

-	Walsh, W.A., and YJ. Chang	January 2015	Standardization of striped marlin Kajikia audax CPUE for the Hawaii-based longline fishery during 1995–2013 using generalized linear models: An update from 2011	ISC Billfish Working Group, Honolulu, HI, Jan. 13-20, 2015, ISC/15/BILLWG-1/03	Workshop Proceedings	http://isc.ac.affrc. go.jp/pdf/BILL/ ISC_15_BILL-1/ ISC_15_BILL- 1_WP02.pdf	Stock Assessment Research Program
	Weijerman, M., E.A. Fulton, A.B. Janssen, J.J. Kuiper, R. Leemans, B.J. Robson, I.A. van de Leemput, and W.M. Mooij	1/21/15	How models can support ecosystem-based management of coral reefs	Progress In Oceanography, online	Journal Article	http://www.science direct.com/science /article/pii/S00796 61114002274	Sustaining Healthy Coastal Ecosystems
	Weijerman, M., I. Kaplan, E. Fulton, B. Gordon, S. Grafeld, and R.E. Brainard	11/13/14	Design and parameterization of a coral reef ecosystem model for Guam	U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA- TM-NMFS-PIFSC-43, 113 pp + Appendices	Report	http://www. pifsc.noaa.gov/ library/pubs/tech/ NOAA_Tech_ Memo_PIFSC_43. pdf, DOI: 10.7289/ V5B27S76	Sustaining Healthy Coastal Ecosystems
_	Williams, I.D., J.K. Baum, A. Heenan, K.M. Hanson, M.O. Nadon, and R.E. Brainard	4/1/15	Human, oceanographic and habitat drivers of central and western Pacific coral reef fish assemblages	PLOS ONE, 10, 5, e0120516	Journal Article	http://www.pifsc. noaa.gov/library/ pubs/Williams_ etal_Plosone_2015. pdf, DOI: 10.1371/journal. pone.0120516	Sustaining Healthy Coastal Ecosystems
	Wurth, T., T. Johanos, J. Baker, and C. Littnan	7/16/14	The Hawaiian Monk Seal: Status, trends, and recovery efforts	22nd Annual Hawaii Conservation Conference, Honolulu, HI, July 15-17, 2014	Presentation		Hawaiian Monk Seal Research Program
-	Yau, A.J.Y., and Y.J. Chang	5/1/15	Summary of striped marlin (<i>Kajikia audax</i>) catch and size data from the Western and Central Pacific Fisheries Commission	ISC Billfish Working Group, Honolulu, HI, Jan. 13-20, 2015, ISC/15/BILLWG-1/05	Workshop Proceedings	http://isc.ac.affrc. go.jp/pdf/BILL/ ISC_15_BILL-1/ ISC_15_BILL- 1_WP05.pdf	Stock Assessment Research Program
	Yeh, F.C., G.H. Balazs, D.M. Parker, C.K. Ng, and H. Shi	7/1/14	Novel use of satellite tracking as a forensic tool to determine foraging ground of a rescued green turtle (<i>Chelonia mydas</i>)	Marine Turtle Newsletter, 142, 1-3	Journal Article	http://www. seaturtle.org/mtn/ archives/mtn142/ mtn142-1.shtml	Marine Turtle Research Program

Appendix I List of Acronyms

ACAP	Association for the Conservation of Albatross and Petrels
ACL	Annual Catch Limit
ACT	Annual Catch Target
AD	Automatic Differentiation
ADCP	Acoustic Doppler Current Profiler
ADD	Acoustic Deterrent Devices
ADMB	Automatic Differentiation Model Builder
AMSEA	Alaska Marine Safety Education Association
APDRC	Asia-Pacific Data Research Center
APEX	Oracle Application Express
ARL	Air Resources Laboratories
ARMS	Autonomous Reef Monitoring Structure
ARSHSL	Archive of Rapidly-Sampled Hawaiian Sea Level
ASCRMP	American Samoa Coral Reef Monitoring Program
ASEAN	The Association of Southeast Asian Nations
ASTP	Advanced Sampling Technologies Program
ATCF	Automated Tropical Cyclone Forecasting (System)
AUV	Autonomous Underwater Vehicle
AVHRR	Advanced Very High Resolution Radiometer
AVISO	Archiving, Validation, and Interpretation of Satellite Oceanographic Data
AWIPS	Advanced Weather Interactive Processing System
BAMS	Bulletin of American Meteorological Society
BET	Big Eye Tuna
BFAR	Philippines Bureau of Fisheries and Aquatic Resources
BMUs	Bioerosion Monitoring Units
BOBLME	Bay of Bengal Large Marine Ecosystem Project
BOEM	Bureau of Energy Management
BotCam	Bottomfish video Camera
BRT	Bycatch Reduction Technology
BRUVS	Baited Remote Underwater Video Station
CAPAM	Center for the Advancement of Population Assessment Methodology
CAPSTONE	Campaign to Address Pacific Monument Science, Technology, and Ocean NEeds
CAU	Calcification Acidification Units
CCA	Canonical Correlation Analysis

CCMA	Center for Coastal Monitoring and Assessment
CFBS	Commercial Fisheries Biosampling
CIE	Center for Independent Experts
CITES	Convention on International Trade of Endangered Species
СК	Chalan Kanoa
CMIP5	Coupled Model Intercomparison Project
CMS	Content Management System
CNMI	Commonwealth of the Northern Mariana Islands
CO-OPS	Center for Operational Oceanographic Products and Services
CoRIS	Coral Reef Information System
CPCe	Coral Point Count for Excel
CPUE	Catch Per Unit Effort
CRCP	Coral Reef Conservation Program
CRED	Coral Reef Ecosystem Division
CRP	Cetacean Research Program
СТ	Coral Triangle
CTD	Conductivity-Temperature-Depth
CTI-CFF	Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security
DAR	State of Hawaii Division of Aquatic Resources
DAS	Department of Atmospheric Sciences
DAWR	Division of Aquatic and Wildlife Resources (Guam)
DENR-BMB	Philippines Department of Natural Resources, Biodiversity Management Bureau
DFW	Division of Fish and Wildlife (CNMI)
DLNR-APO	Department of Land and Natural Resources-Administrative Procedures Office
DLNR-DAR	Department of Land and Natural Resources-Division of Aquatic Resources
DM	Data Management
DMSC	Data Management Stewardship Community
DMWR	Department of Marine and Wildlife Resources (American Samoa)
DODS	Distributed Ocean Data System
DSCTP	Deep Sea Coral and Technology Program
DSS	Data Server Systems
E-EAFM	Essentials Ecosystem Approach to Fisheries Management
EAFM	Ecosystem Approach to Fisheries Management
EAFM LEAD	Ecosystem Approach to Fisheries Management for Leaders, Executives and Decision Makers (LEAD)
ECC	Exploration Command Center

ECOFISH	Ecosystems Improved for Sustainable Fisheries Project
EEZ	Exclusive Economic Zone
EK60	split-beam echo sounder
ENIO	Equatorial and Northern Indian Ocean
ENSO	El Niño Southern Oscillation
EOD	Ecosystem and Oceanography Division
ESA	Endangered Species Act
EX	Okeanos Explorer
FAO	Food and Agriculture Organization of the United Nations
FCMA	Fishery Conservation and Management Act
FDCC	Fisheries Data Coordinating Committee
FEAT	Fishery Ecosystem and Analysis Tool
FFA	Forum Fisheries Agency
FFS	French Frigate Shoals
FishSET	Spatial Economic Toolbox for Fisheries
FMAP	Fisheries Monitoring and Analysis Program
FMP	Fishery Management Plan
FOT	Final Outturn
FP	Fibropapillomatosis
FRMD	Fisheries Research and Monitoring Division
FSM	Federated States of Micronesia
FSWP	Fishery Statistics of the Western Pacific
FUS	Fisheries of the United States
FY	Fiscal Year
GCOS	Global Climate Observing System
GDS	GrADS DODS Server
GECCO2	German contribution to the Estimating Circulation and Climate of the Ocean Phase II (ECCO2)
GEOSS	Global Earth Observation System of Systems
GIS	Geographic Information System
GLOSS	Global Sea Level Observing System
GMSL	Global Mean Sea Level
GNSS	Global Navigation Satellite System
GODAE	Global Ocean Data Assimilation Experiment
GOES-R	Geostationary Operational Environmental Satellite-R Series
GPCP	Global Precipitation Analysis

Global Positioning System
Grid Analysis and Display System
NOAA research vessel Hi'ialakai
Hawaii Administrative Rules
High-frequency Acoustic Recording Package
Elemental Mercury
Particulate Mercury
Hawaii Information Consortium
Habitat In Your Neighborhood
Hawaiian Monk Seal
Hawaiian Monk Seal Research Program
Hawaii Ocean Time-series
High Resolution Picture Transmission
Hawaii Undersea Research Laboratory
Institutional Animal Care & Use Committee
Inter-American Tropical Tuna Commission
Interactive Calibration of Four Dimensions
Integrated Coral Reef Monitoring Program
Integrated Ecosystem Assessment
Information Portal
International Pacific Research Center
Inouye Regional Center
International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean
Information Technology
International Union for Conservation of Nature
Integrated Water Level Service
Japan Agency for Marine-Earth Science and Technology
Joint Institute for Marine and Atmospheric Research
Ministry of Fisheries and Marine Affairs of Indonesia
Live Access Server
Land-Based Sources of Pollution
Leaders, Executives and Decision-Makers
Light-Emitting Diode
Length Frequency Species Composition
Philippines Local Government Units

LHP	Life History Program		
LSS	Life Support System		
LTMP	Long-Term Coral Reef Monitoring Program		
MAPCO2	Moored Autonomous pCO2 System		
MARAMP	Marianas Archipelago Reef Assessment Monitoring Program		
MDP	Marine Debris Program		
MEPS	Marine Ecology Progress Series		
MHI	Main Hawaiian Islands		
MKWC PW	Mauna Kea Weather Center Precipitable Water		
MLO	Mauna Loa Observatory		
MMPA	Marine Mammal Protection Act		
MOUSS	Modular Underwater Stereoscopic System		
MPA	Marine Protected Area		
MTMNM	Marianas Trench Marine National Monument		
MTRP	Marine Turtle Research Program		
MWR	Morale, Welfare and Recreation		
NASA	National Aeronautics and Space Administration		
NCEAS	National Center for Ecological Analysis and Synthesis		
NCRMP	National Coral Reef Monitoring Program		
NEPA	National Environmental Policy Act		
NESDIS	National Environmental Satellite, Data, and Information Service		
NGO	Non-Governmental Organization		
NIST	National Institute of Standards and Technology		
NMFS	National Marine Fisheries Service		
NOAA	National Oceanic and Atmospheric Administration		
Non-USAPI	Non-U.S. Affiliated Pacific Islands (Nauru, Honiara, Funafuti, Penrhyn, Kanton, Christmas, Rarotonga, Papeete, and Rikitea)		
NOS	National Ocean Service		
NOWRAMP	Northwestern Hawaiian Islands Reef Assessment and Monitoring Program		
NPAWG	North Pacific Albatross Working Group		
NSF	National Science Foundation		
NWHI	Northwestern Hawaiian Islands		
NWS	National Weather Service		
NWSFO HFO	National Weather Service Forecast Office, Hawaii Forecast Office		
OAR	Office of Oceanic and Atmospheric Research		
OCC	Ocean and Climate Change		

OCONUS	Outside Continental United States		
ODBC	Developer and Open DataBase Connectivity		
OER	Office of Ocean Exploration and Research		
OES	Oscar Elton Sette		
OPeNDAP	Open-source Project for a Network Data Access Protocol		
OST	Office of Science and Technology		
OTDPS	Oracle Turtle Data Processing System		
OWCP	OceanWatch - Central Pacific		
PacIOOS	Pacific Islands Ocean Observing System		
PaCIS	Pacific Climate Information System		
PARR	Public Access to Research Results		
PCF	Parallel Computing Facility		
PDF	Portable Document Format		
PEAC	Pacific ENSO Applications Climate Center		
PI	Principal Investigator		
PICSC	Pacific Islands Climate Science Center		
PICSI	Pacific Islands Deep-Sea Coral and Sponge Initiative		
PIFSC	Pacific Islands Fisheries Science Center		
PIR	Pacific Islands Region		
PIRE	Partnerships for International Research and Education		
PIRO	Pacific Islands Regional Office		
PIROP	Pacific Islands Regional Observer Program		
PMEL	Pacific Marine Environmental Laboratory		
PNG	Papua New Guinea		
POST	Pacific Ocean Science and Technology		
PR	Pacific Region		
PRD	Protected Resources Division		
PRECI	Protected Resources Environmental Compliance Initiative		
PRH	Pacific Region Headquarters		
PRIAs	Pacific Remote Island Areas		
PRIMNM	Pacific Remote Islands Marine National Monument		
PRSN	Puerto Rico Seismic Network		
PSD	Protected Species Division		
PSG	Pacific Seabird Group		
PTWC	Pacific Tsunami Warning Center		
PYSO	PIFSC Young Scientist Opportunity		

RAID	Redundant Array of Independent Disks
R/V	Research Vessel
RAMP	Reef Assessment and Monitoring Program
RDMA	Regional Development Mission of Asia
REA	Rapid Ecological Assessment
REBYC-II CTI	Strategies for trawl fisheries bycatch management, FAO Project
RFMOs	Regional Fishery Management Organizations
RGM	Reactive Gaseous Mercury
RIFT	Real-time Inundation Forecast of Tsunamis
RMS	Root Mean Square
ROMS	Regional Ocean Modeling System
ROV	Remotely Operated underwater Vehicle
RPL	Regional Purse-Seine Logsheet
S&T	Science and Technology
SAP	Stock Assessment Program
SCADA	Supervisory Control and Data Acquisition
SCEP	Statewide Cultural Extension Program
SE	NOAA research vessel Oscar Elton Sette
SEAFDEC	Southeast Asia Fisheries Development Center
SEAPODYM	Spatial Ecosystem and Population Dynamics Model
SFD	Sustainable Fisheries Division
SFI	Sustainable Fisheries Initiative
SIS	Scientific Information Services
SOD	Science Operations Division
SOEST	School of Ocean and Earth Science and Technology
SOL	Solomon Islands
SPC	Secretariat of the Pacific Community
SPTT	South Pacific Tuna Treaty
SQL	Structured Query Language
SSC	Scientific and Statistical Committee
ST6	Science Information Division
STEM	Science Technology Engineering and Math
STR	Subsurface Temperature Recorder
SWFSC	Southwest Fisheries Science Center
SWS	SeaWater System
TDS	THREDDS-DODS Server

THREDDS	Thematic Real-time Environmental Distributed Data Services			
TIGA	Tide Gauge Benchmark Monitoring Project			
ТММС	The Marine Mammal Center			
TPPG	The Tropical Pacific Proving Ground			
ТРТ	Tropical Pacific Testbed			
TRMM	Tropical Rainfall Measuring Mission			
TRP	Turtle Research Program			
TSI	Territorial Science Initiative			
TZCF	Transition Zone, Convergence Front			
UAS	Unmanned Aerial System			
UCLA	University of California Los Angeles			
UFA	United Fishing Agency			
UH	University of Hawaii			
UH NREM	University of Hawaii, Department of Natural Resources and Environmental Management			
UHDAS	University of Hawaii Data Acquisition System			
UHSLC	University of Hawaii Sea Level Center			
UL	Unloading Log			
USAID	United States Agency for International Development			
USAPI	U.S. Affiliated Pacific Islands (Guam, Palau, Yap, Pohnpei, Majuro, Kwajalein, and Pago Pago)			
USFWS	United States Fish and Wildlife Service			
USGS	United States Geological Survey			
USV	Unmanned Surface Vehicle			
UTC	Coordinated Universal Time			
UV	Ultraviolet			
VARS	Video Annotation and Reference System			
VFP	Visual Fox Pro			
VMS	Vessel Monitoring System			
VSM	Value Stream Mapping			
WCATWC	West Coast and Alaska Tsunami Warning Center			
WCPFC	Western and Central Pacific Fisheries Commission			
WHOI	Woods Hole Oceanographic Institution			
WHOTS	WHOI Hawaii Ocean Time-series Station			
WPacFIN	Western Pacific Fisheries Information Network			
WPFMC	Western Pacific Fisheries Management Council			
WPRFMC	Western Pacific Regional Fishery Management Council			

Appendix II List of Awards and Related Amendment Numbers

JOINT INSTITUTE FOR MARINE AND ATMOSPHERIC RESEARCH (JIMAR) COOPERATIVE AGREEMENT NA11NMF4320128

List of Projects described in the Annual Report for the period: July 1, 2014-June 30, 2015

IIILE	NOAA Technical Lead/Sponsor	Amendment Number(s)
A Biogeographic Assessment of Reef Fishes, Fisheries, and Benthic Assemblages in Hawaii	Matt Kendall	108
ADMB Open Source Project	Michael Seki	24, 74, 109
Bio-Sampling	Michael Seki	9, 52, 101
Cetacean Research Program	Michael Seki	28, 47, 78, 98
Characterization & Dynamics of Mesoscale and Submesoscale Oceanic Variability in the Solomon Sea Simulated by a Nested ROMS Model	Christopher Sabine	62, 87, 114
Database of Marine Cultural Heritage Artifacts Offshore within the Hawaiian Islands	Hans Van Tilburg	115
Economics of Fisheries Initiative	Michael Seki	18, 46, 85
Ecosystem Modeling	Michael Seki	22, 68, 81
Ecosystem Observations and Research Program	Michael Seki	10,63,102
Enhancement of Data and Research Activities for Climate Studies at the International Pacific Research Center (IPRC)	Howard Diamond	29, 65, 104
Fisheries Monitoring and Support	Michael Seki	16, 44, 99
Formulation of Localized Sea Level Rise / Coastal Inundation 'Extremes' Scenarios for Pacific Islands	John Marra	66
Hawaiian Monk Seal Northwestern Hawaiian Islands Research Seasonal Support	Michael Seki	64, 86, 117
Hawaiian Monk Seal Research Program	Michael Seki	7, 17 (sup), 61, 72 (sup), 91
Human Dimensions of Fishing and Marine Ecosystem in the	Michael Seki	12,60,92
Western Pacific		
Western Pacific Investigation of Ecological Constraints for Bumphead Parrotfish	Michael Seki	2
Western Pacific Investigation of Ecological Constraints for Bumphead Parrotfish Main Hawaiian Islands Deep 7 Bottomfish Fast Track Project	Michael Seki Michael Seki	2 31,43,106
Western Pacific Investigation of Ecological Constraints for Bumphead Parrotfish Main Hawaiian Islands Deep 7 Bottomfish Fast Track Project Marine Turtle Research Program	Michael Seki Michael Seki Michael Seki	2 31, 43, 106 8, 59, 96
Western Pacific Investigation of Ecological Constraints for Bumphead Parrotfish Main Hawaiian Islands Deep 7 Bottomfish Fast Track Project Marine Turtle Research Program Mechanisms of Atmospheric Mercury in Transport and Transformation in the Remote Pacific Marine Free Troposphere Measured in Hawaii	Michael Seki Michael Seki Michael Seki Russell Schnell	2 31, 43, 106 8, 59, 96 1, 48, 80, 119
Western Pacific Investigation of Ecological Constraints for Bumphead Parrotfish Main Hawaiian Islands Deep 7 Bottomfish Fast Track Project Marine Turtle Research Program Mechanisms of Atmospheric Mercury in Transport and Transformation in the Remote Pacific Marine Free Troposphere Measured in Hawaii National Weather Service Pacific Region Fellowship Program	Michael Seki Michael Seki Michael Seki Russell Schnell Raymond Tanabe	2 31, 43, 106 8, 59, 96 1, 48, 80, 119 34, 69, 90
Western Pacific Investigation of Ecological Constraints for Bumphead Parrotfish Main Hawaiian Islands Deep 7 Bottomfish Fast Track Project Marine Turtle Research Program Mechanisms of Atmospheric Mercury in Transport and Transformation in the Remote Pacific Marine Free Troposphere Measured in Hawaii National Weather Service Pacific Region Fellowship Program Ocean Remote Sensing	Michael Seki Michael Seki Michael Seki Russell Schnell Raymond Tanabe Michael Seki	2 31, 43, 106 8, 59, 96 1, 48, 80, 119 34, 69, 90 23, 45, 82
Western Pacific Investigation of Ecological Constraints for Bumphead Parrotfish Main Hawaiian Islands Deep 7 Bottomfish Fast Track Project Marine Turtle Research Program Mechanisms of Atmospheric Mercury in Transport and Transformation in the Remote Pacific Marine Free Troposphere Measured in Hawaii National Weather Service Pacific Region Fellowship Program Ocean Remote Sensing Optimizing Routine Ocean Current Measurements by the NOAA Fleet	Michael Seki Michael Seki Michael Seki Russell Schnell Raymond Tanabe Michael Seki Mark Van Waes	2 31, 43, 106 8, 59, 96 1, 48, 80, 119 34, 69, 90 23, 45, 82 105
Western Pacific Investigation of Ecological Constraints for Bumphead Parrotfish Main Hawaiian Islands Deep 7 Bottomfish Fast Track Project Marine Turtle Research Program Mechanisms of Atmospheric Mercury in Transport and Transformation in the Remote Pacific Marine Free Troposphere Measured in Hawaii National Weather Service Pacific Region Fellowship Program Ocean Remote Sensing Optimizing Routine Ocean Current Measurements by the NOAA Fleet Pacific ENSO Applications Center (PEAC)	Michael Seki Michael Seki Michael Seki Russell Schnell Raymond Tanabe Michael Seki Mark Van Waes Raymond Tanabe	2 31, 43, 106 8, 59, 96 1, 48, 80, 119 34, 69, 90 23, 45, 82 105 29 (sup), 35, 67, 112
Western Pacific Investigation of Ecological Constraints for Bumphead Parrotfish Main Hawaiian Islands Deep 7 Bottomfish Fast Track Project Marine Turtle Research Program Mechanisms of Atmospheric Mercury in Transport and Transformation in the Remote Pacific Marine Free Troposphere Measured in Hawaii National Weather Service Pacific Region Fellowship Program Ocean Remote Sensing Optimizing Routine Ocean Current Measurements by the NOAA Fleet Pacific ENSO Applications Center (PEAC) Pacific Island Region Observer Program Initiative	Michael Seki Michael Seki Michael Seki Russell Schnell Raymond Tanabe Michael Seki Mark Van Waes Raymond Tanabe Michael Tosatto	2 31, 43, 106 8, 59, 96 1, 48, 80, 119 34, 69, 90 23, 45, 82 105 29 (sup), 35, 67, 112 27, 54
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Profiling CTD Float Array Implementation and Ocean Climate Research	Christopher Sabine	11,70,93
Protected Resources Environmental Compliance Initiative (PRECI)	Michael Tosatto	13, 51
Scientific Advice and Coordination for NOAA Office of Exploration and Research's 2015-2016 "CAPSTONE" Operations in the Pacific	Jeremy Potter	118
Sea Turtle Bycatch Mitigation Research	Michael Seki	19, 58
Seasonal Forecasts and Extreme Event Projections for Pacific Island Sea Level	John Marra	15
Ship-based GPS Sensing of Precipitable Water	Mitchell Goldberg	116
Stock Assessment Research Program	Michael Seki	25, 50, 94
Sustaining Healthy Coastal Ecosystems	Michael Seki	3, 21 (sup), 73, 107
Tropical Pacific Testbed (TPT) for GOES-R Application Development	Steven Goodman	37
University of Hawaii Sea Level Center	David Legler	38, 76, 97
University of Hawaii Sea Level Center (GNSS installation at NOAA CO-OPS stations)	David Legler	97
University of Hawaii Sea Level Center (Ship-Based Tsunami Detection and Characterization)	David Legler	97
Western Pacific Fisheries Economic Integration	Michael Seki	88
Western Pacific Fisheries Information Network (WPacFIN)	Michael Seki	14, 53, 84
Appendix III Visiting Scientists

DATE	NAME/AFFILIATION	PURPOSE OF VISIT
05/18/14- 05/23/14	Steven Martell Quantitative Scientist International Pacific Halibut Commission Seattle, WA	Participate in Review Panel for the 2014 Stock Assessment Program Review.
06/22/14- 07/25/14	Tenaya Norris Marine Scientist The Marine Mammal Center Sausalito, CA	Participate on cruise to the NWHI to deploy the annual HMSRP field camps.
07/17/14- 07/20/14	Changik Zhang Professor Pukyong National University Busan, Korea	Participate in the ISC14 Science Seminar on Impacts of Climate Change on Tuna and Tuna-like Species as a member of an expert panel and presenter.
11/17/14- 11/18/14	Anne Cohen Tenured Associate Scientist Woods Hole Oceanographic Institution Woods Hole, MA	Present at the Ocean Acidification Conference.
12/06/14- 12/14/14	Johannes Loschnigg Consultant Loschingg Consulting Hood River, OR	Collaborate and present a seminar on recent work on politics of climate change.
12/02/14- 12/09/14	Jerome Aucan Research Scientist Institut de Recherche pour le Developpement Noumea, New Caledonia	Discussed topics related to wave and water level research, particularly about infragravity waves study off the north shore of Oahu.
01/19/15- 01/21/15	Anne Cohen Tenured Associate Scientist Woods Hole Oceanographic Institution Woods Hole, MA	Participate as a member of the Coral Reef Ecosystem Division's (CRED) delegation to the Intergovernmental Oceanographic Commission (IOC) Sub-commission for the Western Pacific (WESTPAC) Ocean Acidification Workshop.
01/29/15- 02/25/15	Michael Spall Senior Scientist Woods Hole Oceanographic Institute Woods Hole, MA	Collaborate on topics relevant to themes of equatorial oceanography, tropical meteorology, and climate research and impacts.
02/19/15- 04/01/15	Emily Donham Research Technician Bigelow Lab for Ocean Sciences East Boothbay, ME	Participate in legs 2 and 3 of 2015 ASRAMP cruise (HA-15-01).

02/22/15- 02/28/15	Mark Lander Professor University of Guam Mangilao, Guam	Discussed decadal climate mode variability in the Pacific with emphasis on impacts in the western equatorial Pacific.
02/23/15- 03/17/15	Michael Gregg Emeritus Professor University of Washington Seattle, WA	Collaborate on ocean mixing research.
03/03/15- 04/15/15	Laura Lilly Staff Research Analyst S. California Coastal Ocean Observing System La Jolla, CA	Participate in Research Cruise SE-15-01 onboard R/V Sette.
04/03/15- 05/03/15	Mareike Sudek Benthic Ecologist Department of Marine Wildlife Resource Pago Pago, AS	Participate in leg 4 of 2015 ASRAMP cruise (HA-15-01).
04/06/15- 04/10/15	Lloyd Lowry Chairman Hawaiian Monk Seal Recovery Team Kona, HI	Participate in the International Collaboration for the Conservation of Monk Seals (ICCMS) workshop.
04/06/15- 04/17/15	Rosa Maria Cordeiro Pires Tecnica Superior Parque Natural de Madeira Funchal Madeira, Portugal	Participate in the International Collaboration for Conservation of Monk Seals workshop.
04/06/15- 04/17/15	Manuel Lourenco Gomes Alves Vigilante Da Natureca Parque Natural da Madeira Funchal, Portugal	Participate in the International Collaboration for Conservation of Monk Seals workshop.
04/06/15- 04/17/15	Mercedes Munoz Canas Biologist Fundacion CBD-Habitat Madrid, Spain	Participate in the International Collaboration for Conservation of Monk Seals workshop.
04/06/15- 04/17/15	Pablo Fernandez De Larrinoa Director, Monk Seal Conservation Program Fundación CBD-Habitat Madrid, Spain	Participate in the International Collaboration for Conservation of Monk Seals workshop.

04/06/15- 04/17/15	Panagioties Dendrinos Coordinator MOm/Hellenic Society for the Study and Protection of the Monk Seal Athens, Greece	Participate in the International Collaboration for Conservation of Monk Seals workshop.
04/06/15- 04/17/15	Luis Gonzalez Garcia Subdireccion General de Medio Natural Direccion General de Calidad y Evaluacion Ambiental y Medio Natural Madrid, Spain	Participate in the International Collaboration for Conservation of Monk Seals workshop.
04/06/15- 04/17/15	Alexandrod Karamanlidis Scientific Coordinator MOm/Hellenic Society for the Study and Protection of the Monk Seal Athens, Greece	Participate in the International Collaboration for Conservation of Monk Seals workshop.
04/08/15- 04/10/15	Jeremy Jackson Emeritus Professor Scripps Institution of Oceanography La Jolla, CA	Keynote speaker for the 2015 Albert L. Tester Memorial Symposium.
05/17/15- 06/02/15	John Davenport Emeritus Professor University College Cork Cork, Ireland	Attend PIFSC's TRP leatherback necropsy workshop to conduct investigations of the thermo-regulatory diving, and orientation anatomy of leatherback turtles.
05/30/15- 06/04/15	Pedro Pinto Manager of Protected Areas Ministry of Agriculture and Fisheries Timor- Leste Dili, Timor Leste	Participate in the Coral Triangle Initiative Ecosystem Approach to Fisheries Management Technical Working Group meeting.
05/30/15- 06/04/15	Rieka Alarii Kwalai Senior Fisheries Officer Ministry of Fisheries and Marine Resources Honiara, Solomon Islands	Participate in the Coral Triangle Initiative Ecosystem Approach to Fisheries Management Technical Working Group meeting.
05/31/15- 06/02/15	Jerald Ault Professor University of Miami Miami, FL	Attended the PIFSC's TRP leatherback necropsy workshop.
05/31/15- 06/07/15	Mark Cane Professor Columbia University Palisades, NY	Discuss various topics related to climate research.

06/10/15- 06/14/15	Allen Foley Research Administrator State of Florida, Fish and Wildlife Conservation Committee Jacksonville, FL	Participate in the Intl Summit on Fibropapillomatosis of Marine Turtles.
06/10/15- 06/14/15	Carlos Diez Biologist Department of Natural Resources of Puerto Rico San Juan, Puerto Rico	Participate in 2015 Intl Summit on Fibropapillmatosis of Marine Turtles.
06/10/15- 06/14/15	Alexandre Girard Manager/President Envirology/Renatura Saint Pere, France	Participate in 2015 Intl Summit on Fibropapillmatosis of Marine Turtles.
06/10/15- 06/14/15	Cecília Baptistotte Coordenador Regional Centrotamar-ICMBio Espírito Santo, Brazil	Participate in 2015 Intl Summit on Fibropapillmatosis of Marine Turtles.
06/10/15- 06/14/15	Colin Limpus Scientific Councillor Convention on Migratory Species Birkdale, Queensland, Australia	Participate in 2015 Intl Summit on Fibropapillmatosis of Marine Turtles.

Appendix IV JIMAR Personnel

Information as of June 30, 2015

Category	Number	High School	Associates	Bachelors	Masters	Ph.D.
Research Scientist	21	0	0	0	0	21
Visiting Scientist	0	0	0	0	0	0
Postdoctoral Fellow	0	0	0	0	0	0
Research Support Staff	106	3	5	69	25	4
Administrative	12	0	0	9	2	1
Total (≥ 50% support)	139	3	5	78	27	26
Undergraduate Students	21	21	0	0	0	0
Graduate Students	17	0	0	14	3	0
Employees that receive < 50% NOAA funding (not including students)	12	0	0	6	1	5
Located at lab (include name of lab)	3 - PMEL 6 - PIRO 119 - PIFSC 4 - ESRL					
Obtained NOAA employment within the last year	2					
Postdoctoral fellows and students from subgrantees	Postdocs: 0 Students: 0					

Appendix V Awards

Annette DesRochers and Amanda Dillon

• NOAA Inouye Regional Center's Green Team Runner up: Department of Commerce Energy and Environmental Stewardship Award for Recycling

Kevin O'Brien

• Nominee for 2014 RCUH Employee of the Year

Brett Taylor

• Virginia Chadwick Award for excellence in scientific publishing as a postgraduate student, awarded by the Australian Research Council Centre of Excellence for Coral Reef Studies, April 2015

Philip Thompson

• 2015 Sackett Prize for Innovative Research for his graduate work completed at the University of the South Florida in 2012

Ashley Tomita

• Nominee for 2014 RCUH Employee of the Year 2014 NOAA PIFSC Scientific Technical Team Member of the Year

Chip Young

• 2014 NOAA PIFSC Scientific Professional Team Member of the Year

Appendix VI Graduates

Vanessa Almanza, MS

"Investigating atmospheric rivers using global positioning systems from ocean transits"

Michele Barnes-Mauthe, PhD

"Social networks matter: Linking resource user's social behavior to coupled outcomes in a marine socialecological system"

Marc Nadon, PhD

"Improving stock assessment capabilities for the coral reef fishes of Hawaii and the Pacific region"

Appendix VII Publication Summary

The table below shows the total count of publications for the reporting period categorized by JIMAR Lead Author, NOAA Lead Author, or Other Lead Author and whether it was peer-reviewed or non-peer reviewed.

		FY15
Peer-Reviewed	JIMAR Lead Author	9
	NOAA Lead Author	11
	Other Lead Author	13
Non-Peer-Reviewed	JIMAR Lead Author	36
	NOAA Lead Author	9
	Other Lead Author	9